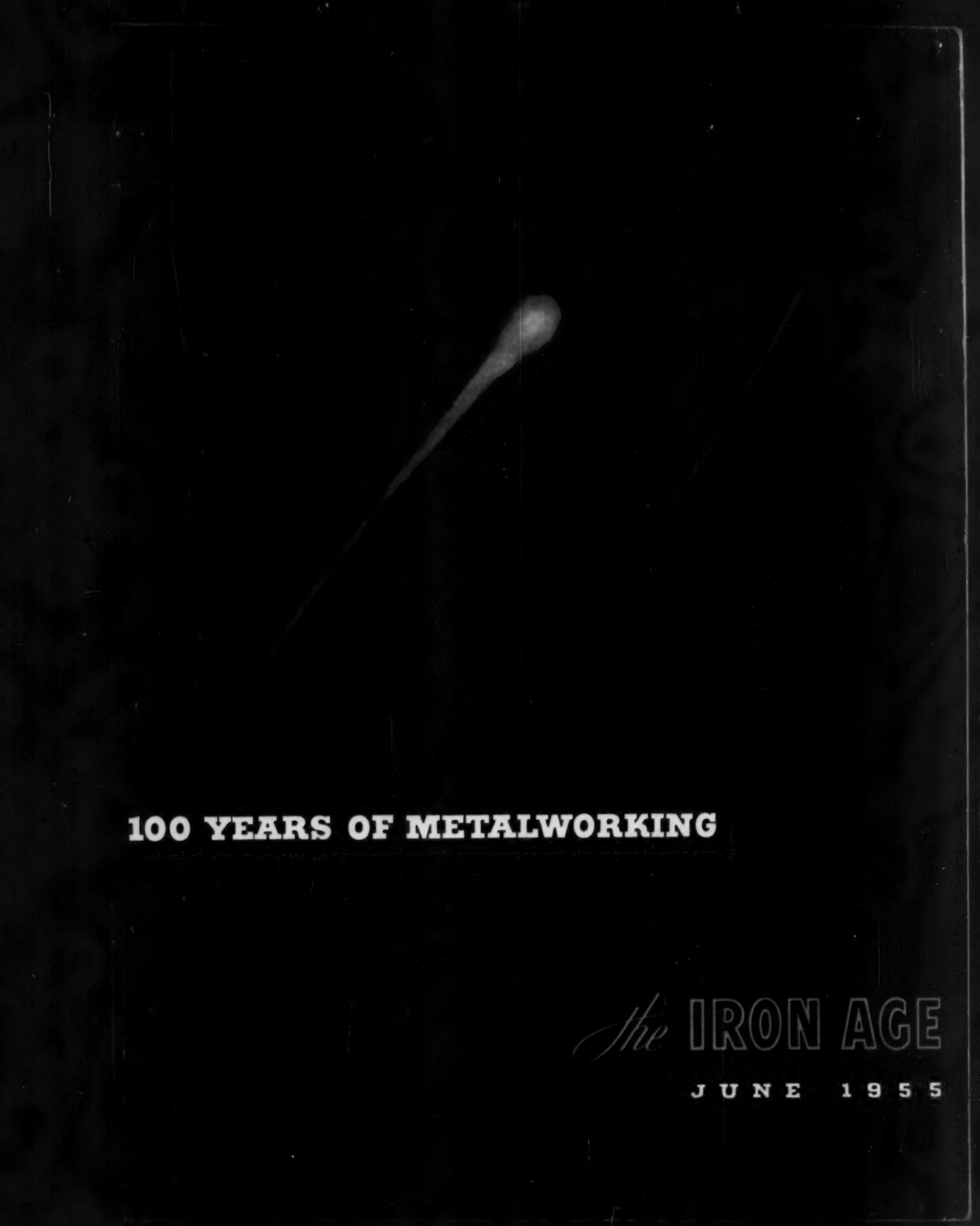
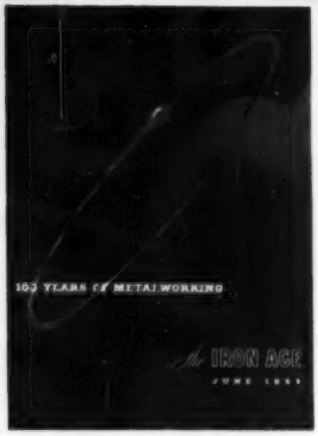


100 YEARS OF METALWORKING

The IRON AGE

JUNE 1955



THIS 100th anniversary issue of THE IRON AGE presents the highlights of a century of progress in metalworking and metal production. You will find the principal emphasis on the results of that progress — on the present status of the industry. Hundreds of engineers and metallurgists have assisted us here and in our efforts to give you a look at the future. We also devote a dozen pages to our own history and some two dozen to the price and production data we have recorded over the years. While it is impossible fully to recognize them all, we dedicate this volume to the many great men and fine companies who have contributed so much to the progress of metalworking and metal production.

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Address mail to 100 E.42 St., N.Y.17, N.Y.

THE IRON AGE 1855-





Founder JOHN WILLIAMS

The following paragraph from THE IRON AGE of January 2, 1873, expresses the aims and ambitions of its founders. Though the phraseology would differ were it written today, the policies and principles still stand exactly as they did then:

To improve *The Iron Age* wherever and whenever improvement was possible; to make its trade reports and prices current, full, comprehensive and invariably accurate; to discuss the most important practical questions of the day honestly and intelligently; to represent in the fullest sense the iron, hardware and metal trades and the great metal working industries of the country, and to make our columns interesting as well as valuable to our readers, has been the constant aim of its conductors; and it would be an affectation of modesty not to see in its expanding circulation, its great and increasing influence, and its extensive advertising patronage, the best evidences that our efforts have been fully appreciated by the public. We need only say, therefore, that we shall follow in the future the policy that has proved so successful in the past, and that with better facilities at our command than ever before, we shall regard success only as an incentive to greater efforts to retain for *The Iron Age*, in its sphere of usefulness, that pre-eminence which it has already gained.

1955



DAVID WILLIAMS, 1841-1927

ONE recent Thursday morning in Pittsburgh a steel company purchasing agent opened his copy of THE IRON AGE and swore softly. The price of No. 1 heavy melting steel had been advanced by a dollar a ton. This was going to cost his company a lot of money.

For a while he toyed with the idea of writing a blistering letter to the editor. But first he made a phone call; he wanted to be sure of his facts. That proved a good idea; for the facts were that a quiet purchase had indeed been made the previous Tuesday. He didn't write the letter.

But a century ago such letters were common. The nation had hardly recovered from the panic of 1873 when a group of hardware jobbers met in convention to denounce THE IRON AGE for having the audacity to print prices. The year was 1876 when these jobbers passed a resolution to the effect that they would not handle the products of any manufacturer who advertised in THE IRON AGE. At that time a midwestern jobber had this to say to a manufacturer who was advertising in THE IRON AGE: "The price quotations in the paper (THE IRON AGE) are simply ruining the chances of doing business. It goes



BIRTHPLACE of THE IRON AGE was this Middletown, N. Y., shop where it was published from 1855 until it moved to New York in 1864.

to every crossroads hardware store in the country and gives the dealer advance notice of every decline in prices. We cannot do business in the face of competition like that." Despite his worries, the jobber did continue to do business, later became a heavy IRON AGE advertiser.

THE IRON AGE not only printed a report of that 1876 convention but it published the resolution with the names of the hardware jobbers who had signed it. It went even further. The editors dug up another resolution signed by a group of jobbers about 20 years previously. In that agreement the jobbers pledged that they would refuse to handle products of any manufacturer who marked his goods with his name or trade mark.

The editors printed the 20-year-old resolution along with the names of the jobbers who had signed it. Then they asked "where are those jobbers now?" All but two of those who were in existence in 1856 were out of business 20 years later. Result was that the boycott of the jobbers who threatened IRON AGE advertisers in 1876 helped the paper rather than injured it.

Today's price reporting merely continues a policy which began in 1855. It started when John Williams, a political revolutionary in Ireland, found himself *personna non grata* to the Crown after the failure of his party to establish political autonomy. His career as a hardwareman was "embarrassed"—he found it "expedient" to leave for the United States. Here he soon began publishing *The Hardware-Man's Newspaper* which in a few years was to become THE IRON AGE.

It is difficult to determine whether the founding of THE IRON AGE was a stroke of vision or a stroke of fortune; perhaps there was a touch of both.

In any event the time was propitious and the environment favorable for growth. Five years earlier the value of the nation's manufactured goods had for the first time exceeded the value of its agricultural products. Yet horses and mules did 79 pct of the work, men did 15 pct and machines only 6.

In 1855 the United States was on the crest of a great wave of expansion. Internal commerce was growing by leaps and bounds, due largely to the Westward movement. Railroads, ceasing to be mere feeders to water routes, were becoming trunk lines east and west.

In 1852 the railroad had reached Pittsburgh and the next year a "white-haired little Scotch devil" named Carnegie started to work for a division superintendent, Tom Scott. Later Scott became president of the road and his nervy little telegrapher drifted into the steel industry.

Railroads reached Chicago from the East in 1853, St. Louis in 1855, and Kansas City in 1856. In 1830 the nation had 23 miles of railroad; in 1840, 2815 miles; in 1850, 9021 miles; in 1855,

"Ahead of the Times"

For a Sound Currency

■ We propose the establishment of a new federal department for the control and circulation of banks throughout the United States, with which all securities for the issue of bills should be lodged, and from which should issue . . . the entire circulation of the country. The nature of the securities to be accepted by this department should, of course, be wisely considered and accurately defined, but should be of such a nature as to render the bills issued upon them entirely secure . . . This system . . . would afford perfect safety to the public in the bank note circulation . . . would prevent the depreciation by one State of the currency of another State, and effectually hinder the unreasonable and extravagant fluctuations in exchange to which the present system is incident. —December 1857.



TYPICAL OF 1859 advertising were these business cards. David Williams was then an apprentice on the paper. Later he called a country printing office "the best school in the world."

18,374 miles, a 100 pct increase in 5 years. In 1860 there were 30,626 miles, an increase of 250 pct in a decade.

Clipper ships, the last flowering of sailing vessels, were at their height. In 1854 the "Flying Cloud" had made its marvelous run from New York to San Francisco and 75 pct of the nation's commerce was carried in American bottoms.

Early advertising in THE IRON AGE was usually in the form of a business card or "reading notice," a mere statement of what was available. A few advertisers had begun to put "sell" into their copy, some overloaded it. Witness an advertisement for spherical "burglar proof" safes "that can not be drilled or sledged" or a circular saw with inserted teeth that "can be run at any speed."

Most gentlemen, of course, had need for pistols. Smith & Wesson ran to straight copy. The Remington Army & Navy Revolver was "warranted superior to any other pistol of the kind!" Marston's Patent Repeater went in for big space (4½ x 9 in.) on page 1, used an "actual size" engraving. This was a three-barrel affair which "can not accidentally be discharged and can be loaded and unloaded in the dark."

Of course, there were countless notices (which grew larger as the years went by) for many companies and their predecessors whose advertising appears in THE IRON AGE today.

John Williams' purpose in starting the paper

Manufacturer of
HORSE SHOE IRON,
(made from the best assorted scraps,)
AUBURN, N. Y.

JOHN H. HASKELL,
MANUFACTURER OF
Oak Tanned Leather,
Belting, and Leather Hose,
33 SOUTH EUTAW STREET, BALTIMORE, MD.

W. & B. DOUGLASS,
Manufacturers of
Pumps, Garden Engines, Pump Chains,
Wrought Butts, &c., &c.,
MIDDLETOWN, CONN.

WHEELER, MADDEN & BAKEWELL,
MANUFACTURERS OF
Warranted Cast Steel Saws,
Of Every Description,
MIDDLETOWN, ORANGE CO., N. Y.

CHARLES WASHBURN & SON,
MANUFACTURERS OF
Bright and Annealed Wire,
Quinsigamond Iron & Wire Works,
WORCESTER, MASS.

THE UTICA SCREW CO.,
Manufacturers of
GIMLET-POINTED SCREWS,
UTICA, N. Y.

SAYRE & REMINGTON,
Manufacturers of
PATENT CULTIVATOR TEETH,
UTICA, N. Y.

AMERICAN HORSE NAIL CO.,
manufacturers of all sizes of
Horse and Ox Shoe Nails,
PROVIDENCE, R. I.

HAYDEN & LETCHWORTH,
MANUFACTURERS OF
Coach & Saddlery Hardware,
AUBURN, N. Y.

G. B. HUBBELL & CO.,
Manufacturers of
CAST STEEL FILES,
ARCADE FILE WORKS,
SING SING, N. Y.

RUSSELL, BURDSALL & WARD,
MANUFACTURERS OF
Bolts of Every Description,
with forged nuts,
PORT CHESTER, N. Y.

JOHN M. STEARNS & CO.,
Manufacturers and Wholesale Dealers in
BEREA GRINDSTONES,
SHOE MAKERS' SAND STONES,
Curriers' Blocks, Kitchen Grindstones; Also Flagging Stone,
BEREA, OHIO.

CHAS. A. CONVERSE & CO.,
Manufacturers of Improved Rolled Twist
Cast Steel Premium Augers,
AND AUGER BITS,
NORWICH, CONN.

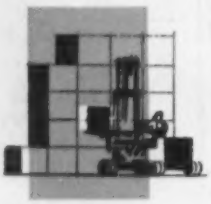
WILLIAM JESSOP & SONS,
Manufacturers and
IMPORTERS OF STEEL,
No. 91 JOHN STREET, NEW YORK.

THE ELIZABETHTOWN
STEAM MANUFACTURING CO.,
Manufacturers of Spokes,
ELIZABETHPORT, N. J.
JAMES W. ANGUS, Superintendent.

"Ahead of the Times"

Overproduction?

■ It only remains then for the manufacturer to solve the problem of how he can manufacture his goods most cheaply; and when he has learned the important truth that, if he can manufacture cheap enough, he can indefinitely increase his production without exceeding the demand for his products, this question may be easily answered.—April 13, 1870.



was to publish prices of hardware items—a much needed service in those days of secret deals, prices and concessions. Listing prices immediately caused serious dissatisfaction among hardware jobbers who felt that no one had a right to publish the market facts.

David Williams, for more than 50 years owner and publisher of IRON AGE, joined his father in the publishing field when *The Hardware-Man's Newspaper* was launched at Middletown, N. Y., in 1855. In the beginning it was a four to eight page monthly. It had obtained wide recognition and was the subject of considerable controversy by the time its name was changed to THE IRON AGE in April, 1859. The paper moved to New York in 1864.

A theory adduced by some who scanned David Williams' old records was that he kept them in Arabic to keep his earnings from the eyes of the idle curious. Mr. Williams was enormously successful and curiosity undoubtedly ran high. The theory has since been proved only partially correct; he used Pittman shorthand, not Arabic.

The pioneering effort of John Williams to print prices of hardware items as a service to customers and dealers later blossomed under David Williams' direction. In the beginning the hardware trade was the major metalworking field. Later the infant iron and steel industry started to grow. And after World War I, mass production, great advances in machinery and in metallurgy formed the basis for the present metalworking industry which accounts for just about half of all industry in the United States. In the fall of 1909 a group of business paper publishers purchased THE IRON AGE and other publications from the David Williams company. One of the new company's first moves was to make a separate magazine out of the hardware department of THE IRON AGE. The new paper became *Hardware Age*.

THE IRON AGE grew as industry grew. It served as a leader, an adviser and a chronicle of important technical news and market trends from the very day of its conception. As long ago as 1873 it urged development of an export trade in "manufactures of iron, more especially machinery, tools and implements of labor, a department of invention in which American genius has achieved a signal triumph."

Starting at the turn of the century, THE IRON AGE expanded its market reporting to include iron and steel products, ore and scrap. Most industrialists then tried to keep their prices secret, felt that the way they ran their business was nobody else's business. Fortunately there were always some men in industry—as there are today—who put the value of news freedom ahead of purely selfish viewpoints.

In 1869 the infant paper added a metallurgical

"Ahead of the Times"

Coming of Manganese Bronze

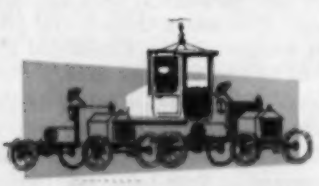
■ Manganese bronze by virtue of greater strength and more reliable character will find an application wherever gun metal is employed, while the facility with which it can be forged, and the benefits it derives from the operation, will render it still more useful as a constructive material. — March 30, 1876.



"Ahead of the Times"

Mass Production

■ Cost of production is diminished in a ratio proportionate to the increased production and, while the price of goods may be lower, the profits are proportionately raised. The cheapness of the goods thus produced will by necessity demand for them a larger market and the manufacturer would find that instead of overproducing he was unable to keep up with the steadily increasing demand. —Apr. 13, 1870.



ADVERTISING of the 1867-1870 era showed the young nation's love for puns. This was beginning of use of engravings. Since they were fairly expensive they were changed infrequently.





column which in 1877 was made into a separate paper, *The Metallurgical Review*, a monthly. It was the first engineering magazine published in the English language. A year later *The Metallurgical Review* merged with THE IRON AGE, marking the birth of what is now its technical section.

Though the heavy emphasis on metallurgy didn't come until 1877, the paper had long reported on new machines, inventions and plants. In 1863 there was a magnificent description of the new Atlas Works rolling mill at Sheffield, England, which employed 2500 men. While its editors continued their policy of wide coverage of new machinery and plants with the cooperation of the producers there developed during the 1930's a new policy. This involved seeking out technical data which some people preferred not to see published but which would be valuable to many. Subjects which were thus explored and tenaciously followed include: Continuous casting, electrolytic tinplate, stainless steel, flame hardening and many new types of rolling mills.

One of the first of these "scoops" was a 1936 report on electrolytic tinplate— "the first radical development in tinning since the year A.D. 77." Details were highly secret and there was much speculation about companies and processes. As it turned out, electrolytic tinplate came just in time to save the nation from a serious food shortage in World War II. And at that time a 16-page article gave a complete status report

BEST INSURANCE FOR IRON MEN.

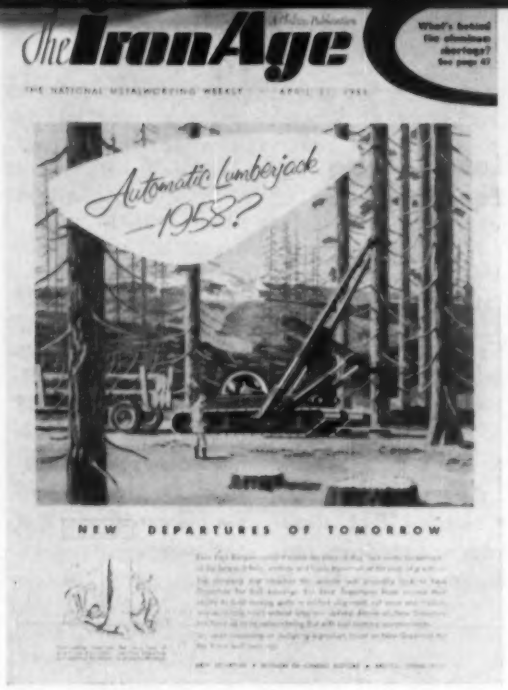
Accident Insurance.



Try a Yearly Policy.

TRAVELERS INSURANCE COMPANY,
OF HARTFORD, CONN.


The Hardware-Man's Newspaper
AND AMERICAN MANUFACTURING CIRCULAR
THE IRON AGE
The Iron Age,
AND
HARDWARE, IRON AND INDUSTRIAL REPORTER.
NEW YORK: THURSDAY, OCTOBER 20, 1865.
MARSTON'S PATENT REPEATER.
The Iron Age.
A Review of the Hardware and Metal Trades.
80 BEEKMAN STREET, NEW YORK: THURSDAY, OCTOBER 12, 1871.
THE IRON AGE
Smokeless Powder Cartridge.
DIAMOND THIMBLES.
Capewell Horse Nails
Are the most perfect of any Horse Nails on the Market.
BESSEMER PIG.
Apollo Best Brand
Bailey
The Iron Age
A Review of the Hardware and Metal Trades.
New York, Thursday, January 5, 1871.



1955

PAGE SIZES varied through the years. By 1871 (the largest shown at left) it had become "unmanageable in size," was cut in half. Smallest format is 1895 issue. Typical current issue is shown above.

on the process that so drastically reduced the need for the tin supply which Japan had cut off.

Several other little known subjects which first saw the light of day in these pages were the Linde flame scarfing process and the hot and cold Sendzimir mills. While little was known of these mills in the U. S., THE IRON AGE was able to secure complete details from Europe.

This permitted it to break the first story (1942) on the Sendzimir cold mill in the United States. Its editors then began following the experimental peregrinations of a Sendzimir planetary hot mill, a process which began in 1948 and required six years before they were able to publish details on the first commercial installation of such a mill.

Except for work done between 1846 and 1857 by Sir Henry Bessemer, the first published report on continuous casting appeared in THE IRON AGE in 1935. Until then this process for going from liquid metal to the rolled product had been in secret commercial production for several years on nonferrous metals. This first prize-winning report was almost sensational in its effects on industry; continuous casting is now, of course, in wide use and readers have been kept posted with more than a dozen major articles on it, including a very definite "scoop" on its first commercial use for steel in 1948.

In 1949 readers received the first report on United States developments in cold extrusion of steel, a process now widely used to make artillery shells as well as some industrial cylindrical parts. This first 16-page article has been followed at 2-year intervals with progress reports to keep readers informed about a process that has a promising commercial potential.

Boron steel developments which also produced a prize-winning article, are another area where IRON AGE editors have led in bringing specific metallurgical information and case histories to readers who urgently needed such data during two war emergencies.

Perhaps because of their contributions to boron steel technology during World War II, the paper's editors were approached during the Korean War by a prominent technical society with the request that they explore its current status. Manufacturers of a host of parts were in a bad jam because of the shortage of alloys. The problem was to tell them how boron steel was being used to secure equivalent hardenability. Although THE IRON AGE had published nine major articles on the subject during World War II, there had been much progress in the meantime.

The result was a 28-page series (1951) on the latest developments in boron steel, an article widely acclaimed by users and suppliers, by the U. S. Government, and by *Industrial Marketing* magazine's contest judges. And so, like Continuous Casting and others before it, it was awarded first prize as the best series of articles published by an industrial magazine during the year.

The magazine has been a constant chronicler

of progress in stainless steel. It carried, in 1939 the first article on electropolishing of stainless. It had begun publication of estimates on stainless steel production and use in 1932 when such data was hush-hush in a highly competitive field. The series on stainless steel production and distribution was continued until 1941 when the American Iron and Steel Institute began issuing official figures.

The first detailed article on assembly of aircraft frames by resistance welding reported on the new Sciaky welding technique which was just then (1940) being investigated by American aircraft manufacturers.

Contrary to popular belief, a relatively small percentage of the magazine's technical pages have been devoted to steelmaking over the years. And a much larger proportion than is generally thought has been devoted to nonferrous metals.

Among the newcomers in this field is titanium, a subject readers clamor for. The record shows a total of 90 news and technical articles in THE IRON AGE between 1950 and 1954 on this subject, most of them major technical articles. Five, published during the last quarter of 1952, won a first prize as the best series in the industrial field during the year.

More recently, subjects like ductile iron, shell molding, powder metallurgy and vacuum melting have been followed. Its editors feel that though production figures or invested capital may be small in some processes they must be intensively covered from their inception. For only by reporting developments in infant industries can their possibilities be fully explored and developed commercially.

Discovery of iron ore in Labrador and Venezuela has had—and will continue to have—an important effect on United States industry. So it is not unusual to find that the first business paper editor to visit the Labrador ore fields was THE IRON AGE editor. In the case of Venezuela, this same editor was the first newspaperman to visit the scene of the huge new find to report on its significance to American industry.

The free exchange of technical information, now taken for granted in the United States, is credited with an important role in improving the American standard of living. And it played a major role in winning World War II.

This is a fact that has not always been recognized. It explains why, for instance, THE IRON AGE found it necessary to publish, during World War II, a booklet entitled "The Pen and the Sword." This volume contained 198 letters, telegrams and purchase orders from the War and Navy Departments, from arsenals and government contractors. They asked for reprints of articles ranging from gaging through cutting tool maintenance to shell and aircraft manufacture. It is to be hoped that current "security consciousness" in Washington will not interrupt the free exchange of legitimate technical information in the nation's business press.

As long ago as 1910 THE IRON AGE was carrying as many as 20 specific reports of technical and trade association meetings each year. Twenty years after that more than 30 such reports per year were submitted to readers. Among the early organizations with which THE IRON AGE pioneered in disseminating industrial and technical information were The American Society For Metals (formerly The American Society For Steel Treating), National Machine Tool Builders Association, The American Iron and Steel Institute and The American Institute of Steel Construction. There are many others covering the whole range of metalworking and metal production which THE IRON AGE has faithfully followed from their founding days.

By the thirties THE IRON AGE was recognized

"Ahead of the Times"

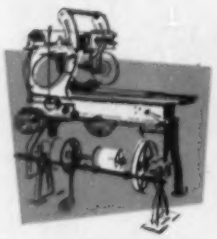
Metal Dirigibles



■ There seems to be no good reason (unless the one of expense) why a balloon, or at least the upper and more exposed half, could not be successfully made from aluminum . . . It would be an advantage with this form of balloon more than any other, to use pure hydrogen, which is considerably lighter than the street gas. — Oct. 2, 1873.

"Ahead of the Times"

Labor Saving Equipment



■ Nothing that stimulates and cheapens production injures life in any sense and the more machinery a nation has in active operation the more fully and profitably is its labor skilled and unskilled employed; the more rapid its material progress toward the highest standard of civilization. — April 11, 1872.

for the accuracy of its price, market and technical reporting. It was coming to be known as "the bible of the industry" and was beginning to establish itself as a market research authority.

Many attempts were made by its editors to obtain from the American Iron and Steel Institute, or from steel producers, statistics indicating "where steel went." In an editorial on Oct. 6, 1921, under the title "Need of a Survey in Steel," THE IRON AGE pointed out that there was a notable lack of exact knowledge in the steel industry concerning its products. Consumption figures bandied about after World War I were literally taken from thin air. Railroads were credited with taking anywhere from 20 to 40 pct of total steel produced—a greatly exaggerated figure.

Because attempts to get the institute to compile official figures at that time failed, THE IRON AGE started its annual survey entitled, "Where Steel Went." This proved so interesting to steel users and so valuable to steel companies that it was taken over by the American Iron and Steel Institute during the 30's. It is now one of the most widely studied reports the institute produces.

This habit of digging new ground for new ideas has gone on continuously since the paper started. Early in the century, information on blast furnace operations, production of pig iron for both foundry and steelmaking use was hard to get locally—impossible to get nationally by areas. So, back in October 1901, THE IRON AGE started gathering monthly statistics on pig iron production. This became one of the first real barometers of business conditions and its reports were long accepted as an index of conditions not only in iron and steel but in all domestic industry.

It took a lot of time to overcome reluctance of blast furnace men to give IRON AGE editors secret production data so that it might be used in an overall figure without divulging the production figures for specific companies. THE IRON AGE's pig iron production figure was released each month from 1901 until World War II when governmental authorities took the stand that such information gave "aid and comfort to the enemy," and so was censored.

The monthly pig iron figure came out the first issue of each month, and the editors frequently worked all night compiling totals from figures wired in at the end of the month. This sort of "newspaper" speed, commonplace today, was most unusual in a "trade" magazine at that time. For years the pig iron production statistics were used by salesmen, business forecasters, ore companies, steel firms and steel customers in determining market conditions.

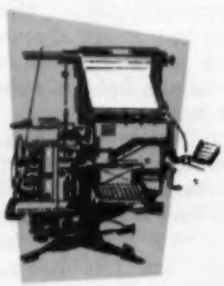
Since the pig iron production figures were divided into 12 geographical districts, the figure was a good gage of the business temperature in various parts of the country. When blast furnaces went down or started up it meant many things besides the movement up or down in coke, ore and limestone. It meant ups and downs for steel and its customers, and it also pointed the way to the ups and downs of the corner grocery in industrial areas.

After World War II, The American Iron and Steel Institute took over the compilation of pig iron production figures and THE IRON AGE series ended. Though the current method of reporting pig iron production is not the same as that formerly used by THE IRON AGE, the fact that the institute issues pig iron statistics is a tribute to the magazine's work in this field.

Somewhat the same situation developed in the publication of steel ingot production data. About 1910 THE IRON AGE recommended that the American Iron and Steel Institute publish

"Ahead of the Times"

Type-Setting Machines



■ The type-setting machine ranks with the steam cotton picker, the field corn husker and the steam plow as one of the greatest mechanical problems and needed inventions of the age.—Mar. 27, 1873.

"Ahead of the Times"

Aluminum for Cooking Utensils

■ Stories have been told and written about poisoning by cooking vessels made of copper, by glazings containing lead, and the formation of verdigris on spoons of alloyed silver; and if people were only determined to produce these utensils from aluminum, all danger from poisoning would be removed, and they would have vessels the appearance and durability of which would scarcely leave anything to desire.—Aug. 28, 1873.



ACCURATE, objective and authoritative reporting have been keystones of editorial policy through the years — as these letters from two great steel leaders attest.

TWO LETTERS 1896

monthly data on the output of steel ingots. (It did publish annual figures.) While such a move was being considered IRON AGE editors and correspondents made monthly checks and published estimates up to 1917. Then the institute took over the job and presented steel firms and customers with official figures. These were among the first basic figures furnished publicly by an association; they represented a victory of far-seeing men in the institute who saw the value of public and commercial relations long before some of their confreres did.

In the U. S. government's suit to dissolve U. S. Steel Corp. many years ago and in the initial and historic Pittsburgh basing point case before the Federal Trade Commission the wide acceptance of THE IRON AGE'S price quotations and market information figured heavily in both cases. Yet the difficulty in building up such a reputation which exists today was far greater than one would suspect.

In years gone by hundreds of thousands of tons of pig iron and finished products were bought and sold on the basis of THE IRON AGE quotations. It is believed that there are probably thousands of cases today where its price quotations are used in connection with price analyses and contracts covering materials far removed from ordinary steel products. But even the latter are, in many cases, bought and sold today on the basis of THE IRON AGE quotations despite the fact that major steel firms now publish prices on their own products.

When times are good in industry, its editors do not hear much from sellers of steel or buyers of steel on prices being quoted. But during periods such as the depression of the Thirties and the temporary but important soft spots in the metalworking field, maintenance of the policies set forth by the founder is not easy. But this challenge has been met, and through the integrity of those men and their successors who believed in THE IRON AGE has come the spirit and the support to carry on the difficult task of unbiased market reporting.

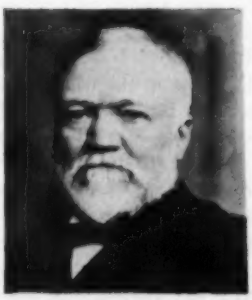
There have been just as many pyrotechnic displays of anger and heated discussion during the long history of the magazine's iron and steel scrap reporting. Its editors have no actual count on the number of contracts which are based on THE IRON AGE scrap quotations, but the number is believed to be very large.

Main job of IRON AGE editors covering scrap markets is to obtain the going price of the various grades and report the market as they see it. Steel leaders and scrap officials have consistently shown their confidence in this technique for reporting the highly active and free playing scrap markets.

There have been squabbles, and there will con-

Turn to page 14

1955



Andrew Carnegie

◆ So THE IRON AGE has led the iron hosts for 40 years, but, unlike its prototype, it has not only seen, but reached the "Promised Land," and enjoys its well earned reward; so has the host it has led through the wilderness of trial and experiment to success.

For 30 years of the 40, I have been one of the pilgrims upon the march with THE IRON AGE. A checkered and crooked path, indeed, it has been, over bogs and morasses, and through floods which swept many comrades away; nevertheless, the vast host has moved steadily in the right direction. In learning by experience much needed lessons, by availing itself of every scientific discovery and every new source of supply, and adapting itself to the wants of the growing Republic, the undisciplined few who began their wanderings under your guidance have become the largest, best disciplined, and most effective army of iron masters in the world . . .

Let us rejoice and unite in congratulating THE IRON AGE upon its long and prosperous career of 40 years, and wish that some day, far in the distant future, this period will be seen to have been only its brief term of adolescence, and that the full maturity of its powers only came with its four-hundredth anniversary.

ANDREW CARNEGIE
New York, 1896



B. F. Fairless

◆ By a happy coincidence, THE IRON AGE was born about the same time the bessemer process introduced the modern age of steel. THE IRON AGE was right there on the job, ready to begin its authoritative, dependable reporting of the progress and achievements in the new era that was beginning. THE IRON AGE and the modern age of steel thus grew up together, knew good and bad times together; and now they have reached the prime of their lives together.

In 1855, when the first issue of THE IRON AGE went to press, we were still a young, undeveloped nation, depending on agriculture as our chief source of the production of wealth. As openhearth furnaces joined bessemer converters in pouring out additional tonnages of steel at economical prices, the workshop of America grew larger and moved at a faster pace. Except for temporary setbacks, America went forward by leaps and bounds, and thirty-nine years after the first issue of THE IRON AGE appeared, this nation was the foremost industrial producer in the world.

New industries have come into existence, turning out new products through the combination of science, American mass production methods, and the American genius for organization. Our standard of living became the wonder of the world, and it knocked the Marxist theories into a cocked hat.

The steel industry is proud of the part it has played in the growth and development of this nation in the past century. But my pride in the contributions of the steel industry is part of a still greater pride in our democratic institutions. They gave the American people the freedom to realize the full potentials of their hands, their brains, and their spiritual aspirations. You do not build dreams if the mind and will are not reasonably free to realize them. And you do not go into a new business, whether making steel or publishing a magazine, unless you have freedom of initiative and expression. But we Americans, under our Constitution, have been free to dream, free to start new industrial enterprises, and free to express ourselves. Everyone who usefully employed these freedoms, from the founding of the Republic, helped build the America we now have.

As we salute THE IRON AGE on its One Hundredth Anniversary, I cannot help being mindful of these things. Successive editors and staffs of your publication have been free to record, year after year, the growth and accomplishments of the steel industry. They have done it accurately, fully, and faithfully, so that THE IRON AGE has won the unqualified confidence of its readers in this country and throughout the world, who wish to know the latest developments in our steel industry. Reading THE IRON AGE *Summary* is a "must" with every person whose business it is to keep an eye on the barometer of steel. The *Summary* is widely quoted and widely respected, and deservedly so.

Congratulations, Iron Age, on a magnificent job! You have carried out the finest traditions of a free press. Your century of service has been invaluable to the steel industry and all related industries.

All of us in United States Steel affectionately say to all of you: "Happy Hundredth Birthday, and may your next century be as successful and as useful to American industry as your first."

BENJAMIN F. FAIRLESS
Pittsburgh, 1955

tinue to be differences of opinion as long as there is scrap iron and steel. But the proof of the reliability of THE IRON AGE scrap prices lies in the contracts which are based on such quotations with the full knowledge that the magazine reports the facts as it sees them.

Its editorial offices, composing room and district offices have long been linked by teletype. This service has proved invaluable in moving copy on markets and prices. By thus pioneering in its field it has been able to provide fresh, accurate news to its readers. By going to press on Tuesday, into the mails on Wednesday and to the desks of most subscribers on Thursday, its readers get "this week's news this week."

Starting in the late Thirties, THE IRON AGE began accurately predicting steel prices and steel wage changes anywhere from a week to several months before they became facts.

These predictions are based on a complete knowledge of the industry and its various personalities. Their accuracy has been recognized by the major wire services—Associated Press, United Press, and the International News Service—which use a great deal of news from THE IRON AGE. (Once a week for more than 50 years in the case of one service.)

Eagle-eyed newsmen on the desks of the wire services and on financial papers throughout the country have used THE IRON AGE market and price summary because they feel it constitutes fresh news. That's why IRON AGE mentions frequently run to over 400 or more a month in the nation's newspapers.

The scoop that comes once in a lifetime to a weekly paper which operates like a daily came in the week of February 11, 1946. That was the week Washington and the industrial world were waiting for the outcome of negotiations between the U. S. Steel Corp., the United Steelworkers of America and the government of the United States. Inspired reports and tips were flying all over the country but real facts appeared to be nonexistent.

There was reason to believe THE IRON AGE might miss the settlement because it went to press on Tuesday, did not reach subscribers until Thursday.

The story on the settlement of what was one of the most costly steel strikes in the country up to 1946 was written for THE IRON AGE on Monday, February 11, by its news markets editor. On Tuesday morning February 12, THE IRON AGE Summary was prepared in which it was stated categorically that: (a) The strike had been settled; (b) the men would go back to work the following Monday; (c) the wage settlement would be 18½¢ an hour; (d) carbon and alloy steel prices would be increased by $5 a ton; and (e) the specific increases would be allocated on the basis of steel distribution but that the average would still be $5 a ton.

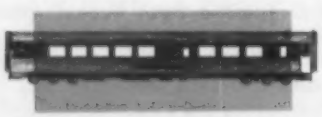
This information was included in a release through the major wire services and to a list of newspapers throughout the U. S. This matter-of-fact release was carried within the next three days by more than 500 newspapers and by at least 60 individual radio announcers. There was no confirmation of THE IRON AGE story from the White House, from the steel union or from U. S. Steel Corp.

This kept the pot boiling and caused many counter stories to be written indicating that THE IRON AGE figures were wrong. But at his press conference at 4:00 pm Friday afternoon, February 15, President Truman announced the

"Ahead of the Times"

Steel Railroad Cars

■ The most obvious remedy, or rather preventive for the danger mentioned (fires in railroad wrecks) is to make the cars incombustible. To do this with iron involves, however, an entire change in car architecture, and one that will annihilate the ornamental appearance now so much in favor, both with railroad men and with the traveling public. Nevertheless, I am disposed to think that eventually iron and steel will form the standard material of car construction, but the time is not near at hand.—May 15, 1873.



"Ahead of the Times"

Automatic Railroad Stops

■ Whether it would not be well to add to them (railroad signals) some means of stopping a train by the volition of the signal man, without necessarily the intervention of brakeman or engineer, is one well worthy of cogitation.—June 19, 1873.



price increase in almost the precise words of THE IRON AGE release, and at 10:30 Friday night February 15, the late Philip Murray announced an 18½¢ an hour increase for the steelworkers. Some time later, U. S. Steel Corp. announced that the price increase averaged $5 a ton but that it would be allocated to various products on a weighted basis.

As indicated by Raine Bennett on February 13, 1946, at 9:30 a.m. over Station WRC, Washington, D. C., the settlement terms were available in the very room where newsmen were awaiting statements by the negotiators. On Tuesday afternoon, February 12, THE IRON AGE had delivered to the wire services for release on Wednesday morning at 7 a.m. its complete story on the wage strike settlement. On Thursday morning, fully a day and half before the official announcement, copies of THE IRON AGE were available at the White House with the published details.

While things like this only come once in a lifetime, the record shows that other price and market information, details on technical and industrial advancements are in the same class with this scoop—if less dramatic.

Not too many years ago (1948) there was a series of price increases in the steel industry. Each week THE IRON AGE interpreted these increases in terms of their cost to steel consumers. In one week, there was a minor increase in semi-finished steel prices—a change in selling methods from gross ton to net ton. Although the price remained the same, naturally there was a small increase in the cost to consumers.

In a routine manner, and as a fourth or fifth paragraph in its weekly steel summary, THE IRON AGE mentioned this minor price increase and added it to the ones which had accumulated over several weeks. For some reason which in retrospect appears rather complex, the small increase in semi-finished steel was played up in the daily press out of proportion to the fact that semi-finished steel constituted less than 10 pct of total steel shipments.

One of the upshots of this was a Senate hearing in which steelmen, notably Benjamin F. Fairless, then president of U. S. Steel Corp., were called to Washington to testify. In the hearing THE IRON AGE stories on the price increases were used as source material. Mr. Fairless was a fortunate choice as a witness because during his entire career he has supported freedom of the press and especially freedom of the trade press.

Currently expressed fears about the impact of automation on employment recall similar theories of the Technocrats. These ivory tower cloud gazers held forth during the depression of the thirties, saw all machinery as a threat to labor. Because there was much straw grasping in those days, the editors produced (1935-1936) six special rotogravure inserts on the economics of mechanization. One subject was "The House that Jack Built." And there was a con-

"Ahead of the Times"

Aircraft in War

■ For military purposes its (the balloon's) value is as yet undreamed of; and inasmuch as the governments of this and other countries are now busied in testing and perfecting the means of submarine warfare, it would be well if those adapted to the upper air should receive more attention against the time of need.—Oct. 23, 1873.



"Ahead of the Times"

Japan Self-Supplying

■ When we consider that all these efforts (toward developing Japanese industry) are the fruit of the last few years, less than a decade, indeed, it is impossible not to see in such industrial development a sure presage of further advance, and the approach of a time, not far distant, when although the Japanese have almost denationalized themselves by the adoption of all things foreign and the creation of a whole circle of new wants, they will be quite able to supply them all from the work of their own looms and shops,

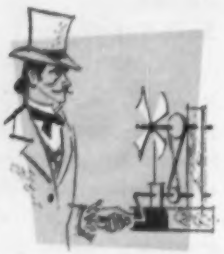


and leave a very small margin for the foreign importer in a market which he fondly hoped would, with its thirty million of inhabitants, afford him a permanently profitable field.—Nov. 18, 1875.

Air Conditioning

"Ahead of the Times"

■ Must we wait till the next generation introduces the latest improvements before we can have both hot and cold air, as well as hot and cold water, in our houses!—Aug. 30, 1877.



Modern Navies

"Ahead of the Times"

■ In the warship of the future, speed and easy handling are qualities which are far more likely to be the objects sought for than protection against shot and shell.—May 31, 1877.



test, "Lightning Struck the Plant . . . and Saved the Business," in which readers re-equipped obsolete plants, figured how loss could become profit.

Market research was virtually unknown in the industrial publishing field in 1932 when THE IRON AGE introduced classification of metalworking plants according to the type of products they produced. In the forties it added a research department and undertook to conduct periodically its own private census of the industry. These findings are now known as THE IRON AGE'S Basic Marketing Data. The latest issue, 1954, classifies 23,300 metalworking plants employing 20 or more workers—according to 187 different product classifications—as well as by plant sizes and employment. The data are now widely used, have proved valuable to many metalworking companies.

Circulation has kept pace with the growth of the industries it serves. From a little less than 12,000 in 1914, it rose to 19,225 in 1944. Now, ten years later, it stands at 44,000.

The makeup and the format of THE IRON AGE have naturally changed with the times. Often it was ahead of them. While the early issues had a 10 x 14-in. page size, they soon blossomed to 18 x 23½ in. in the 1860's. This is about a fifth larger than today's *New York Times*. By 1873 the page size was down to a handier 19 x 13. By this time a 32-page issue was more or less standard and the advertisements were beginning to get considerably larger than the "business cards" of the 1860's.

In recent years its format has been changed several times to make it easier to read, more valuable to the busy executive. This is why, in addition to the usual contents page, there is a facing digest of major articles of the week. This too, explains its stress on departmentalization, its wide use of subheads, crossheads and boxed highlights. And there are no "continuations" to the back of the book.

As for thickness, it has always had a rather heavy reputation. A standard joke among subscribers in the 1870's was that if they were to continue to get the magazine they would have to build bigger offices. Its size was the subject of a line in a Broadway play during the 1920's. The scene called for someone to be hit on the head with something large and with quite an impact. So the line was, "Hit him with a copy of THE IRON AGE!"

The policy of publishing dynamic editorials, originally established by John Williams, has continued for the past 100 years and will continue as long as the paper lives. Few if any of the basic policies and motives which produce this national industrial magazine have been changed.

When THE IRON AGE became one of the twelve major papers in the present Chilton Company group, it carried on just as it did under David Williams and under his successors. In recent years the tempo of news, technical and market reporting has been stepped up.

As we enter the atomic age, the editors have already laid their plans to be among the first to report on new metals, new machines and new techniques. And they will continue their efforts on the human side, covering labor and management in the same vein as the paper's founder and with the same belief that men—not machines alone—make industry.

"Ahead of the Times"

The Atom Bomb

■ Industry sources believe that Russia has the means of producing an atomic bomb, and will demonstrate one within the following year. Industry sources have been unable to convince the U. S. government, however. — Dec. 16, 1947.





This mill, shown near completion at Bethlehem in 1907, was the first in America to roll wide-flange structurals.



The Kelly Converter, developed in 1857 at the Johnstown plant, was the forerunner of the Bessemer process.

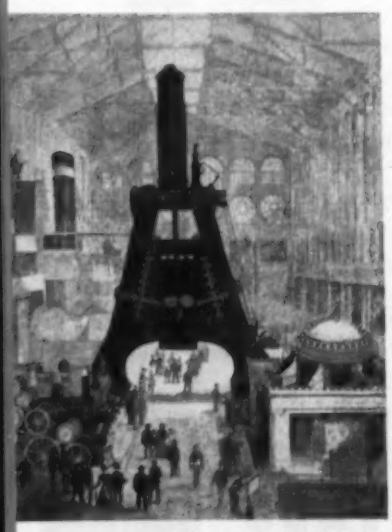


The huge Ferris wheel at the 1893 Chicago World's Fair had a 56-ton forged axle made at the Bethlehem plant.

MARKING THE 100TH BIRTHDAY OF A GREAT PUBLICATION



This was the laboratory at Bethlehem where in 1898-99 Frederick Taylor and Maunsell White made their historic discovery of high-speed tool steel.

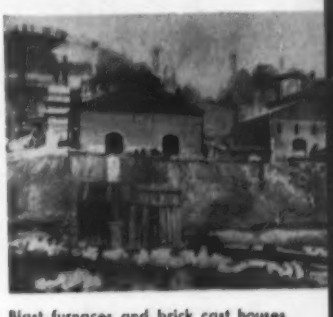


Among exhibits at the World's Fair in Chicago in 1893 was this replica of a 125-ton hammer, the original of which was installed at Bethlehem in 1891.

The first issue of *The Iron Age* came from the presses at a moment when the Bessemer process and other epochal developments that ushered in the modern steel industry were just around the corner. From that day to this the pages of *The Iron Age* have ably chronicled the industry's development and growth. With our congratulations on the completion of its first hundred years we extend to *The Iron Age* our every good wish for many more years of continued service.

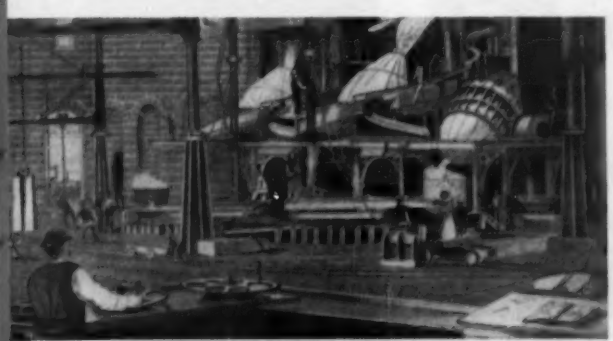
This birthday provides an occasion to bring out our own family album and to present a few pictures from the lusty days when the industry was young.

At the present pace of progress who can say how long it will be before the modern equipment we gaze on so fondly today will look as dated as some of the early scenes presented here? *Please turn the page.*



Blast furnaces and brick cast houses at the Johnstown plant, as they looked in 1876, year of the famous Centennial Exposition, held in Philadelphia.

BETHLEHEM STEEL



This battery of Bessemer converters at Steelton plant was an impressive concentration of steelmaking capacity back in the 1870's.

BETHLEHEM STEEL

BETHLEHEM STEEL CO.
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation



"Wet-drawing" unit, with spindles centered in wooden vats, photographed in the wire and rod mill at Johnstown plant, in the early 1900's.



First shipments of pelletized iron ore from the new Bethlehem mine at Marmora, Ontario, Canada, have already been made.



Huge new blast furnace at Bethlehem, Pa., is one of nine such giants built in Bethlehem steel plants since the end of World War II.



Enlarging of Bethlehem, Pa., plant's facilities to roll structural shapes, now virtually completed, increases capacity by 50 per cent, to 210,000 tons a month.

"We Intend to Keep Pace With That Growth"



New continuous galvanizing unit at Sparrows Point plant. Recently announced expansion program will further substantially increase Sparrows Point's capacity in galvanized sheets.

Early in 1955, E. G. Grace, chairman of Bethlehem Steel, announced a new $100,000,000 expansion program. This, together with $93,000,000 authorized for completing new construction as of December 31, 1954, will bring Bethlehem's total outlay for expansion and modernization since the end of World War II to over $1,000,000,000.

In describing the objectives of the new program in the March, 1955, issue of the *Bethlehem Review*, Mr. Grace said, "We believe that the country will continue to grow and that the national output of goods and services will continue to grow also. It is our intention to keep pace with that growth."

The photographs that appear on this page illustrate a few phases of recent and current expansion and modernization in Bethlehem Steel plants.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

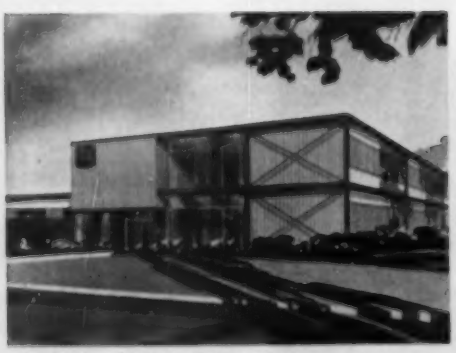
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BETHLEHEM STEEL

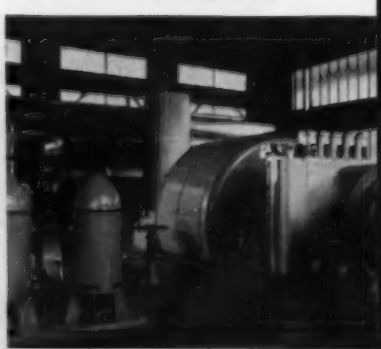
BETHLEHEM STEEL



Two 21-in. stands and a flying shear were added last year to Lackawanna plant's 21-in. billet mill.



Rendering of offices and drafting room for new Torrance, Calif., fabricating works of Bethlehem Pacific.



Turbo-blower at Steelton plant, installed to keep pace with increased blast-furnace capacity.

The IronAge

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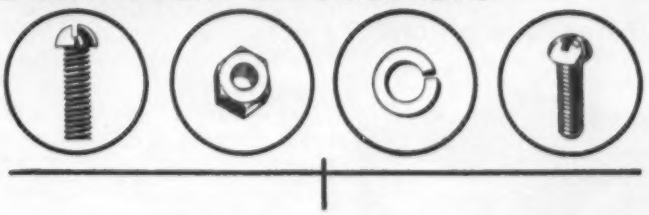
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EPA NBP

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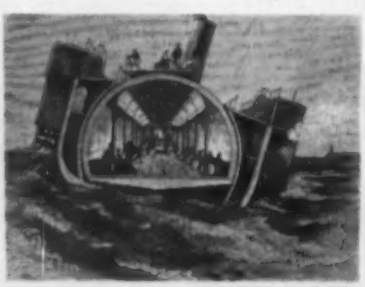
Abstracts from past issues of THE IRON AGE, *selected for their flavor, and with some regard for whimsy:*

The Bessemer Ship Performs Well

An eyewitness of the test run by the Bessemer channel steamer says in *The Iron Age* of April 1, 1875:

"Your readers will be desirous of learning what experience we had with the suspended Bessemer saloon, and with the hydraulic machinery for working it. Part of this machinery was still in some minor respects incomplete; but in the course of this morning the lashings of this large and heavy structure were cast off, and it was taken charge of by the Bessemer apparatus, which worked it for the space of an hour or two, with a heavy beam sea still running. It was very satisfactory to find that this apparatus appeared to have full command over the saloon, and was capable of oscillating it easily in either direction at the will of the manipulator. The manipulation was effected by a man holding a short lever in each hand, and moving them as nearly as he could in accordance with the oscillations of the ship, and it can scarcely be doubted by those who saw the operation that with a little practice the desired object will be fully accomplished."

Apr. 1, 1875



Bettmann Archive

SUSPENDED saloon of Bessemer's ship resisted rolling in choppy sea.

When you need DECAL NAMEPLATES

★ for identification
★ for trade marks
★ for operating instructions . . .

Make sure they're designed, engineered and made by MEYERCORD

We make decal nameplates to meet the exacting requirements of every commercial surface and finish. This means we make many different types . . . some highly resistant to wear, some resistant to heat, others to meet still different requirements. The important fact is that the Meyercord Nameplate Decals you use are specially engineered to your specific needs. This all adds up to easier, faster application and longer, trouble-free service. Let one of our trained and experienced sales engineers give you all the facts about Meyercord service and engineered-quality. No obligation, of course.

Ask for your Copy of Meyercord "MARK-IT" Manual

This valuable manual is yours free . . . request it on your letterhead, please. In full color, it contains important information for adopting Meyercord Decal Nameplates to reduce costs and improve product identification.



Send for it today!

THE MEYERCORD CO.
World's Largest Decalcomania Manufacturers
Dept. G-313, 5323 West Lake St., Chicago 44, Ill.



Inland's production balance, ever-sensitive to the varying requirements of midwestern industry for a wide range of carbon steel products, is a real advantage to steel users.

INLAND STEEL COMPANY
38 South Dearborn Street • Chicago 3, Illinois
Sales Offices: Chicago • Milwaukee • St. Paul
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Principal Products: Sheets • Strip • Structural
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CRANE 1855

100 YEARS OF SERVICE TO



Richard Teller Crane preparing to pour castings in his first foundry—July 4, 1855 *

"It is my aim to place our plant in advance of all others in the country . . . in variety and quality of goods . . . to carry everything that is called for in this line . . . to anticipate the wants of the trade . . . to bring out in advance articles I could see would be needed . . . and to be honorable in all our dealings."

Richard Teller Crane—"Autobiography"

*From Crane's motion picture "The Second Hundred Years."

On these principles CRANE starts its Second Century of Service to the Metal-Working Industries

CRANE 1955

THE METAL-WORKING INDUSTRIES

CRANE begins its Second Century of Service in a new era . . . as different from the old as steam power differs from sail power!



CRANE valve for atomic submarine "Nautilus."

At the beginning of Crane's first century, we had to control only simple fluids—like water and steam.

Our second century begins as *nuclear power* brings new, unheard-of problems to solve.

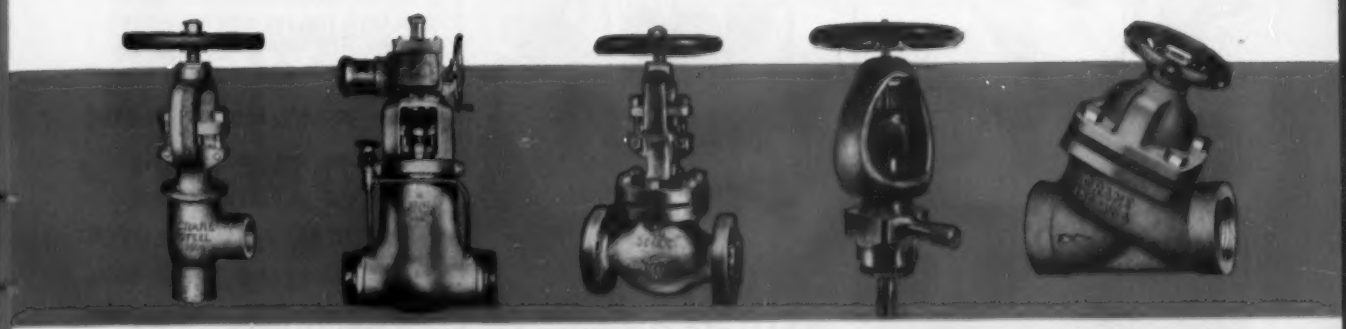
What once was sufficient in design and strength in valves, fittings and piping may soon be obsolete. New processes and machines demand controls for new high pressures and temperatures . . . new corrosion-resistant materials . . . new, tighter, safer seals . . . new norms of performance.

Crane is taking these new challenges in its stride. Our scientists are far advanced in the study of ways to control the flow of nuclear materials, to master new fields of metallurgy and chemistry. And our pooled resources of ingenuity and know-how in design and production will deliver Crane Quality products capable of serving the needs of our customers satisfactorily through a second century.

1855 CRANE CO. 1955

General Offices: 836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • KITCHENS • PLUMBING • HEATING



CRANE Lip-seal valves—handle steam safely at temperatures up to 1200° F.

CRANE Pressure Seal Bonnet valves—for high-pressure/high temperature power services—utilize line pressure to keep the bonnet joint tight.

CRANE Arctic Steel valves—operate freely at temperatures of —175° F or lower.

CRANE high-pressure valves—withstand pressures up to 30,000 p.s.i. (15 tons).

CRANE Diaphragm valves—exclusive refinement of packless design—handle corrosive fluids, high vacuum, and abrasive slurries.

YOU CAN PROFIT FROM TMI *Precision* EXPERIENCE

☆ **PURCHASING**

TMI has a reputation for meeting and beating precision specifications. We protect you 100% and live up to our delivery promises.

☆ **DESIGNING**

From precision demands of newest instrumentations to top secret nuclear power developments—TMI engineers work with you with progress in mind—always!

☆ **MANAGING**

TMI close tolerance tubing can do much to reduce your machining costs and save time on your production line . . . while improving the performance of your product. You can *profit* from our precision experience.



TUBE METHODS INC.

METALLURGISTS • ENGINEERS • MANUFACTURERS

BRIDGEPORT (Montgomery County), PA.

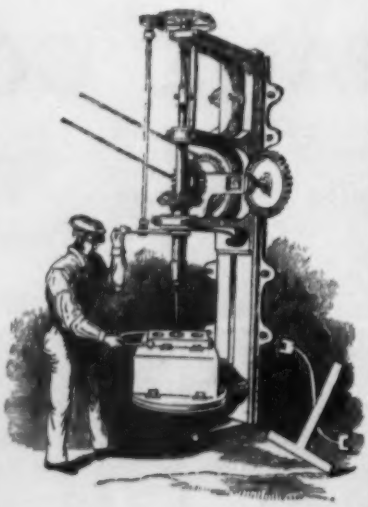
American Made Steel Would Set Us Free

Up to the present time, the steel consumed in this country has been, with few unimportant exceptions, imported from Europe, and we must in candor admit that those exceptions were of inferior quality, and fit only for the lowest uses.

All cast steel requiring to be well refined and of high temper, as well, indeed, as all blister steel of good description, has hitherto been made from Swedish or Russian iron, in Sheffield; and this article, so essential to the manufacturing interest of the country, and for which we have been thus far entirely dependent upon a foreign market, is, with the characteristic wisdom of our national commercial policy, made subject to a heavy duty.

It is therefore a question of grave importance to the industry of the country, whether it is possible to manufacture good steel at home from American iron. Nothing would so surely and so speedily emancipate us from our industrial vassalage to England, as the ability to convert our own ores into such steel as we are now compelled to buy of her.

June, 1859



Bettmann Archive

BORING MACHINE as shown in engraving of old machine shop.

For hand-in-glove mileage



be sure to order Jomacs

Flexibility and hard wear are qualities that make Jomac® Work Gloves your best buy in hand protection. Describe your plant operations, temperature conditions, etc., and we'll gladly recommend an economical Jomac for the job, and send you a free sample pair. Jomac Inc., Dept. B, Philadelphia 38, Pa.



JOMAC 644—SAFETY CUFF GLOVES, made of extra-heavy Jomac cloth, give maximum protection to workers' hands. They outwear leather gloves, retain flexibility, can be cleaned and reconditioned many times. Reversible—fit either hand, any two make a pair.

It pays to keep Jomacs on hand

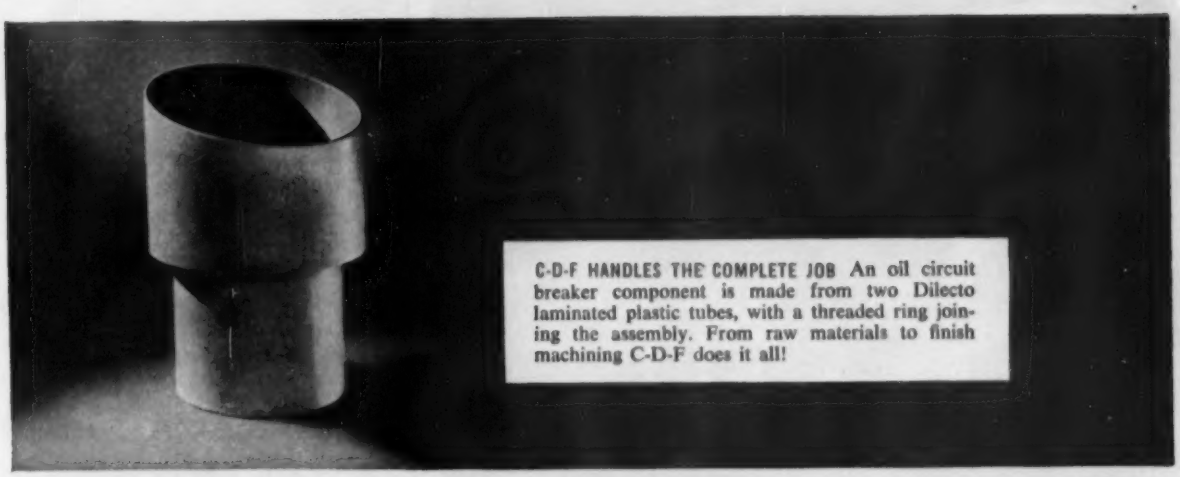
JOMAC

INDUSTRIAL WORK GLOVES

Outwear ordinary work gloves by 900%

Plants in Philadelphia, Pa., and Warsaw, Ind.

IN CANADA: Safety Supply Company, Toronto.



C-D-F HANDLES THE COMPLETE JOB An oil circuit breaker component is made from two Dilecto laminated plastic tubes, with a threaded ring joining the assembly. From raw materials to finish machining C-D-F does it all!



C-D-F KNOWS HOW TO MACHINE PLASTICS. A bus bar gets a covering of molded Dilecto over copper supplied by the customer. The plastic ends are skillfully trimmed on a smooth saw.

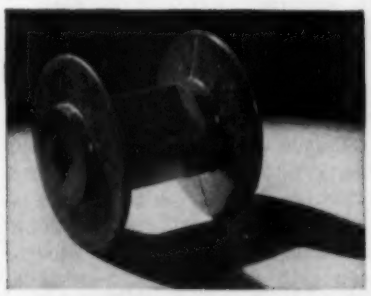


C-D-F MOLDS MANY SPECIALTIES. This shaft insulator for a circuit breaker is molded from C-D-F's cloth-based industrial thermosetting plastic, Celoron. Note complexity of mold, clean detailing.



C-D-F USES MODERN METHODS. Large quantities of arc chute barriers are made from paper-based Dilecto. Operations include pressing, cutting, post-forming and trimming.

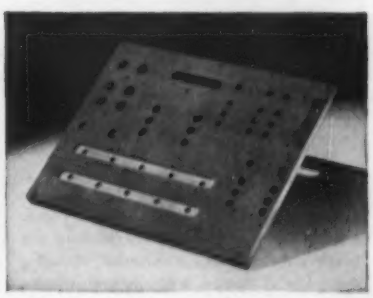
Dependable equipment relies on C-D-F insulation!



C-D-F OFFERS UNIQUE MATERIALS. This contact shaft for an air circuit breaker is another example of molded C-D-F Celoron used in switchgear because of its high impact strength.



C-D-F IS A SKILLFUL ASSEMBLER. Made from Grade C rolled Dilecto tubing, these pots are turned, bored, slotted. Then a macerated plastic end is inserted and arc resistant varnish finish applied.



C-D-F UNDERSTANDS THE ELECTRICAL INDUSTRY'S NEEDS. Precisely machined to close tolerances, Dilecto panel boards guarantee dependable insulation, help designers save space.

See our catalog in Sweet's Design File for basic product data and sales offices. Write for detailed information, or send us your print for quotation.

CDF *Continental-Diamond Fibre*

CONTINENTAL-DIAMOND FIBRE COMPANY

NEWARK 85, DELAWARE



FOR LESS THAN $40 YOU GET 12 SETS, EACH SET GROUND READY TO GO

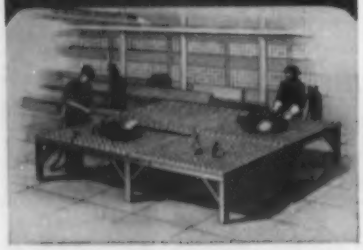
Men would not accept either idea at first . . .

INSERT CHASERS SAVE UP TO 33%

Insert chasers are like safety razor blades: they cost so little that you can throw them away when dull. Or, for utmost economy, you can resharpen them over and over again. Only a flash grind is required. For less than $40 you get a dozen sets of ⅝–16 insert chasers, each set ground ready to go. You will be amazed at the quantity of threads they will cut, even to Class 3 specifications, with a minimum of downtime. FREE: "Selecting the Proper Die Head for the Job"

THE EASTERN MACHINE SCREW CORPORATION, 21-41 Barclay Street, New Haven, Conn.

BENDING BLOCKS or WELDING PLATENS



Semi-steel Blocks for layout, welding, assembly work, etc., with machined working surfaces; also tools and accessories, including a full line of clamps, drift pins and dogging devices. Standard and special stands can be supplied. A 4-unit set-up, joined and mounted on stands, is shown above.

WRITE TODAY FOR LITERATURE

ACORN IRON & SUPPLY CO.

Delaware Avenue at Poplar Street
Philadelphia 23, Pennsylvania

Can We Manufacture For Ourselves—Or Not

Our article on this subject this month, must be brief, but not the less emphatic, as we shall call attention to a comprehensive class of manufactures, in which, beyond cavil or question, Americans excell all other nations—we mean *Labor-saving Machines.*

Work Savers Sought

The necessities of the country called into exercise and stimulated naturally the genius of the people in this direction. The scarcity and the consequent dearness of labor arising from the sparseness of the population and the vast extent of the region they inhabited, made it a matter of great importance to economize labor as much as possible, and to find all practicable aids and substitutes for human work; and so we find a national aptitude for the construction of implements of every kind, which is recognized under the proverbial name of "Yankee ingenuity."

Sometimes this may display itself in the construction of an Apple Parer or a Pencil Pointer; sometimes in a Sewing Machine or a Reaper; but whatever may be its special manifestation, the fact stands uncontradicted that, in this most important class of manufactures, America is without a rival.

Many Tools Available

The same principle applies to all implements of husbandry—spades, hoes, plows, harrows, mowers, reapers, etc. In all these the American farmer is furnished by the skill of his own countrymen with such implements of husbandry as are enjoyed by no other nation upon earth.

And so in Mechanics' tools; where do we find such axes, such adzes, such augers, such drawknives, such socket chisels, and we will add, such saws? so beautifully adapted to the wants of the Mechanic and so well suited to diminish his labor.

Ingenious Contrivances

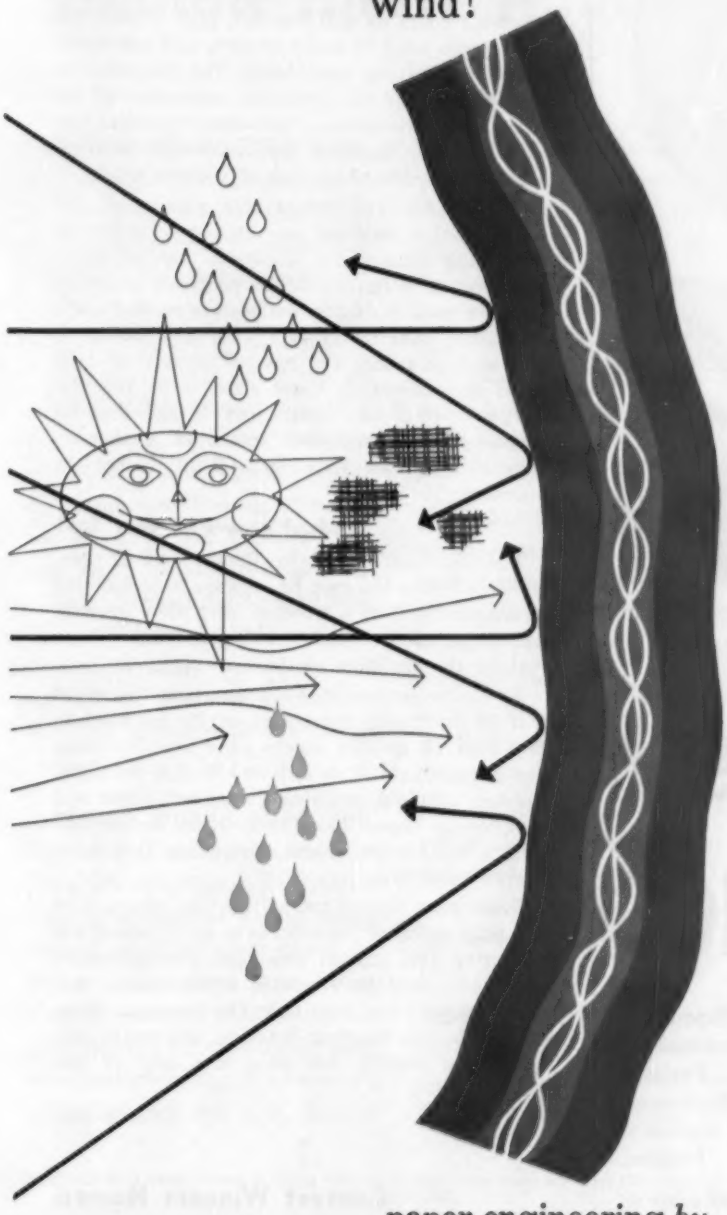
And then think of the ten thousand ingenious contrivances which distinguish this country above all others for saving trouble in our households and our workshops. Space fails us or we might furnish a list that would fill a column.

But we cannot close without referring to those two crowning triumphs of American ingenuity, the Printing Press and the Sewing Machine. What mighty results have flowed and will yet flow from the improvements made by American skill in the former—what a mighty social revolution is the latter working! And this is the fruit of native talent and the result of domestic industry.

We have more to say on this branch of our subject but our space fails, and we must defer until our next. We think however, we have given proof enough for one month of the ability of Americans to manufacture for themselves.

June, 1859

this wrap-around shield keeps out more than wind!



This is a cross section of a new paper developed by Cromwell as a wrap for sheet steel shipped by barge. Only Cromwell could "build-in" this wide range of protective abilities in a single sheet...

EXTRA-WATERPROOF
OIL RESISTANT
EXTRA-STRONG
SCRATCHPROOF
FLEXIBLE
VOLATILE
CORROSION INHIBITION

This new Cromwell sheet consists of two heavyweight sheets of kraft, blond laminated for high waterproofness, oil resistance and moistureproofness. It is reinforced with just enough specially selected glass fibers to provide strength and prevent a tear, but not enough to injure flexibility. The entire structure is embossed for flexibility. One wall of kraft is treated with Ferro-Pak VCI to prevent rust. Printed for brand or company identification.

A versatile paper like this may be just what you've been looking for. But whatever your needs, Cromwell "Paper Engineering" can give you the bag, cover or liner with the *right* combination of protective qualities. Write us about your problems.

paper engineering *by*

CROMWELL

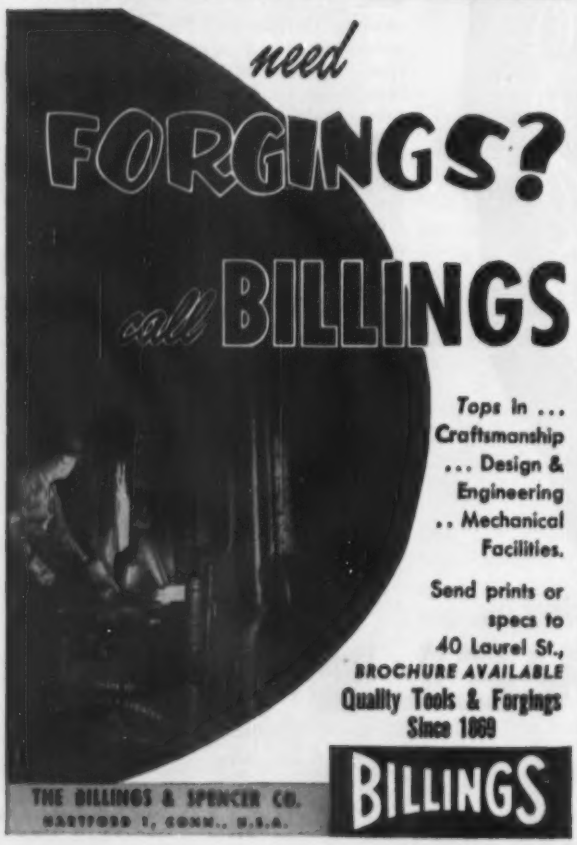
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For further information, write 150 Canal Street

CLARK BROS BOLT CO.
MILLDALE CONN



Roller Skating Mania Taxes Market Supply of Boxwood

In less than one year the price of boxwood has trebled. The roller skating mania has completely exhausted the market of a certain size of boxwood. Less than 18 months ago a ton of 3 inch boxwood could be sold for $38, and it would be first-grade wood in every respect, and admirably suited for turning small work. The demand then was steady, and the principal consumers of the wood were rule makers, tool manufacturers and turners, who supplied the market with boys' tops, spools, pins, and toys of various kinds.

The sudden and remarkable growth of the roller skating pastime has created a constantly increasing demand for a certain size of wood, and now it is impossible to purchase a ton of suitable wood for $120. Rollers are made in several sizes, ranging from 1⅝ to 2⅛ inches in diameter, and only the natural growth of boxwood approximating these sizes is fit for use. Large wood is too costly, and is less firm in resisting the tremendous strain of a skater's weight upon an axle only 7/32 inches in diameter.

Product grows in Near East

The boxwood grows in Persia and Turkey, and heretofore the crop has always been handled in England. It is a wood of very slow growth, and in its native country stringent timber laws restrict the depletion of the growing trees.

At the present rate of consumption, the world will be practically exhausted of its boxwood in less than 12 months unless some equally cheap and durable substitute is found to take its place. Rubber, celluloid, rawhide, vulcanized fibers and compressed paper have been tried in making rollers, but for one reason or another they have proved unsatisfactory.

Some have proved too soft, while others, like the pure celluloid wheels, have been found too expensive for general sale, and the necessary metal bushings have proved objectionable, because the grit and dust from the floor and shoes of the skaters wearing between two metal surfaces, has rapidly cut away the axle of the skates.

Apr. 2, 1885

Contest Winners Named

Winners of THE IRON AGE contest to locate the oldest existing issue were presented their awards at a luncheon May 23. Top award of $500 was received by the Engineering Societies Library for their issue dated Jan. 2, 1873. Second prize of $100 was awarded the Schumacher-Kelley Co., Inc., Freehold, N. J. for their issue dated June 17, 1875.

What the Metalworking Industry Should Know About Superior Tube

ONE SOURCE FOR ALL YOUR NEEDS. Superior makes the widest range of alloys available in tube form—offers you as standard products what many firms would classify "specialty" tubing. You can get round or shaped tubing to standard specifications or to your own design. You can get capillary tubing, pointer tubing, oval and flattened tubing for Bourdon springs, electronic tubing, pressure and superpressure tubing, telescopic sizes and large O.D. light wall tubing. Over 55 analyses are available in carbon, alloy and stainless steels; in nickel and nickel alloys; in beryllium copper, titanium, zirconium. All analyses are available in .010" to 5/8" O.D. and certain analyses in light walls up to 2½" O.D.

SUPERIOR WORKS WITH YOU. Superior is a specialty redraw mill that produces tubing to your specifications. No finished sizes of tubing are carried in mill stock except for sample experimental lots. Every order is produced as it is received. Our engineers are thoroughly familiar with small tubing, its production techniques and end uses, because Superior has always worked closely with users and fabricators of tubing in nearly every industry. It is their aim to supply you with the *right* analysis in the *right* temper with the *right* finish to fit your particular problem or condition.

Superior is more than willing to tackle your smallest developmental order—and more than able to handle your largest production order.

SUPERIOR QUALITY. The quality which users have come to expect from Superior tubing is no overnight accomplishment. Rather, it is the result of years of experience plus a continuing search for improved production and control methods. That is why Superior can offer you close tolerances; bright, clean O.D. and I.D. surfaces ready for fabrication; and a thorough metallurgical control of quality. Superior tubing is a constant; its behavior, in production and end use, is predictable order after order.

SUPERIOR METHODS. To apply precision methods and quality controls to the production of tubing, we have developed many laboratory, production and inspection techniques which are unique with Superior—nondestructive testing for one instance, or either the vacuum or controlled atmosphere annealing of cold-drawn materials for another. Our physical, chemical and metallurgical labs conduct thousands of tests annually as part of the control of tempers, finishes, tolerances, etc. The results of these tests are available to you without charge.

Although Superior carries no mill stock, distributor warehouses the country over stock standard analyses in many sizes and tempers for prompt shipment.

Superior's tube specialists will be glad to work with you in developing, designing and producing the tubing you need. If you have a problem involving tubing, write or wire at once. For further technical information, ask for Bulletin 40. It's free. Just fill in and mail the coupon.

FREE TECHNICAL INFORMATION

SUPERIOR TUBE COMPANY
2004 Germantown Ave., Norristown, Pa.

Please send me by return mail a free copy of Bulletin 40, "A Guide to the Selection and Application of Superior Tubing."

Name_____

Title_____

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Round and shaped tubing available in Carbon, Alloy and Stainless Steels; Nickel and Nickel Alloys; Beryllium Copper; Titanium; Zirconium

Superior Tube

The big name in small tubing

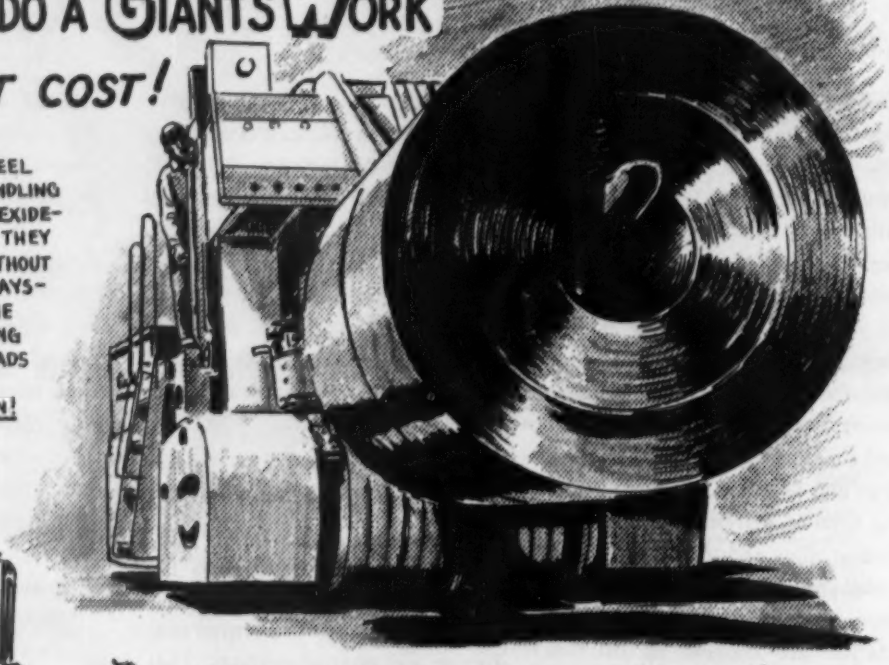
West Coast: Pacific Tube Company, 5710 Smithway St., Los Angeles 22, Calif. RAymond 3-1331

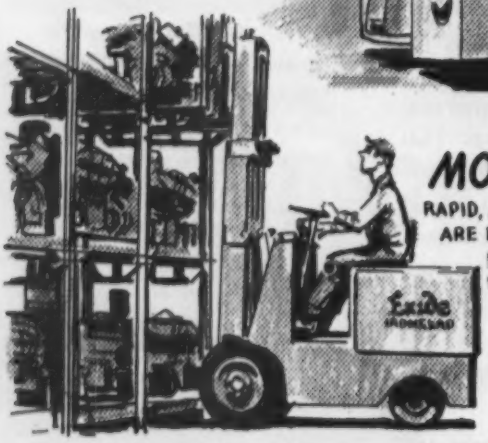
All analyses .010" to ⅝" O.D.
Certain analyses in light walls up to 2½" O.D.

FACTS ABOUT Exide® INDUSTRIAL BATTERIES

IRONCLADS DO A GIANT'S WORK AT LOWEST COST!

MEN WHO WORK WITH STEEL SAVE BIG MONEY BY HANDLING BULKY MATERIALS WITH EXIDE-POWERED RAM TRUCKS. THEY WORK FULL-SHIFT--WITHOUT COSTLY DOWN-TIME DELAYS-AROUND THE CLOCK. THE DEPENDABILITY AND LONG USEFUL LIFE OF IRONCLADS RESULT IN LOWEST HANDLING COSTS PER TON!





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RAPID, ACCURATE HANDLING...PRECISE SPOTTING ARE EASY WHEN YOU USE EXIDE-POWERED ELECTRIC LIFT TRUCKS. STACK HIGHER AND NEATER-WITHOUT FUMES, NOISE, COSTLY DELAYS.

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QUICK, SURE STARTS. POSITIVE OPERATION OF CONTROLS. THAT'S WHAT EXIDE-IRONCLAD DIESEL STARTING BATTERIES DELIVER-LOW-COST POWER EVERY DAY FOR YEARS.



TUBES OF POWER

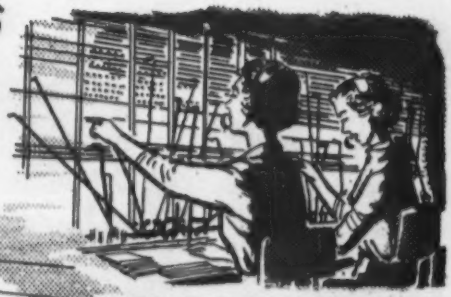


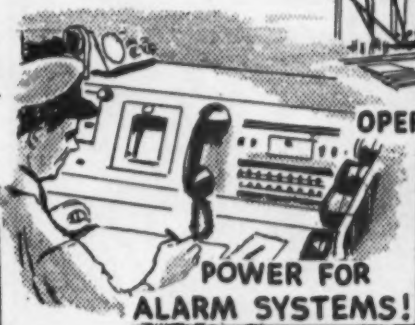
INSIDE EVERY IRONCLAD ARE SLOTTED TUBES THAT KEEP THE ACTIVE MATERIAL IN FIRM CONTACT WITH CONDUCTING GRIDS OF THE POSITIVE PLATES. THE ELECTROLYTE FLOWS EASILY THROUGH THESE NON-CORRODING SLOTS TO REACH MORE ACTIVE MATERIAL FASTER. RESULT: AN IRONCLAD DELIVERS GREATER POWER... FOR A LONGER TIME... AT LOWEST COST!

PROTECTED CONDUCTING GRID
COMPRESSED ACTIVE MATERIAL
SLOTTED RETAINER TUBE

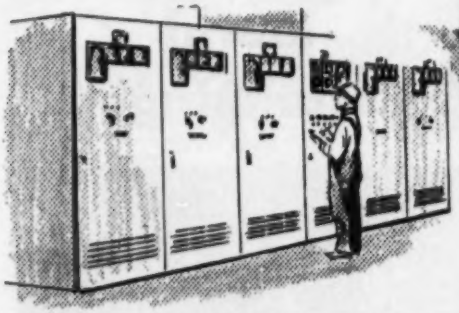
EXIDE-MANCHEX® PROVIDES ABSOLUTELY DEPENDABLE POWER FOR VITAL PLANT SERVICES

WHEN EMERGENCIES INTERRUPT THE NORMAL FLOW OF ELECTRIC POWER, PLANTS RELY ON AN INDEPENDENT—DEPENDABLE—SOURCE OF STANDBY POWER! THIS BIG JOB IS BEST GIVEN TO EXIDE-MANCHEX BATTERIES. THEIR INSTANT, AMPLE POWER DOES ALL FOUR JOBS—*AT LOWEST COST.*

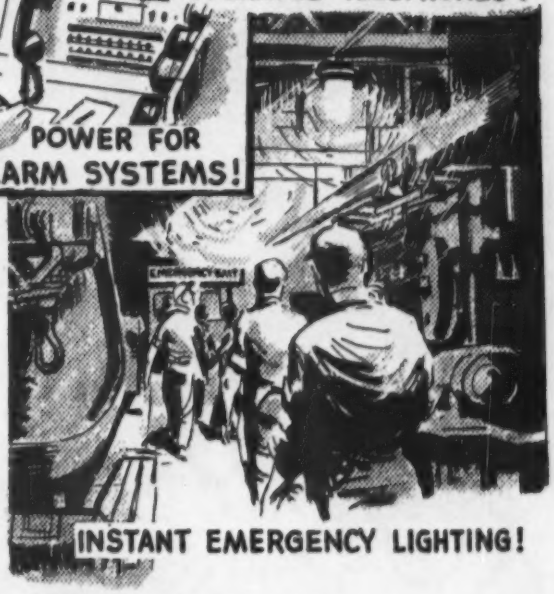




OPERATES TELEPHONES!



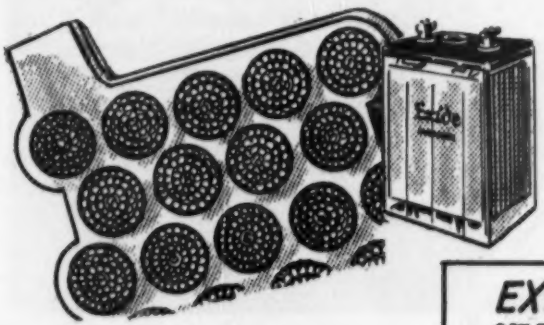
POWER FOR ALARM SYSTEMS!



INSTANT EMERGENCY LIGHTING!

KEEPS SWITCHGEAR WORKING!

POSITIVE OPERATION OF SWITCHGEAR IS THE MOST VITAL NEED OF A PLANT DURING ANY EMERGENCY. EXIDE-MANCHEX BATTERIES ASSURE DEPENDABLE SWITCHGEAR PERFORMANCE-PROVIDE INSTANT POWER FOR FAST TRIPPING-YET HAVE ADEQUATE RESERVE POWER FOR OTHER CONTROL CIRCUITS AND EMERGENCY LIGHTING.



BUTTONS OF LEAD

EXIDE'S MANCHEX BATTERIES GET THEIR DEPENDABILITY AND LONG LIFE FROM BUTTONS OF PURE LEAD INSERTED IN THE GRID OF THE POSITIVE PLATES. THEY GIVE YOU HIGH CAPACITY IN A COMPACT SPACE – UNUSUALLY LONG BATTERY SERVICE LIFE!

CALL YOUR EXIDE SALES ENGINEER FOR HELP IN SOLVING YOUR BATTERY PROBLEMS. SINCE 1888 EXIDE HAS BEEN HELPING THE METAL WORKING INDUSTRY DO MORE WORK EASIER...FASTER... AT LOWEST COST. IS EXIDE HELPING YOU?

EXIDE'S ULTRA START® BATTERY

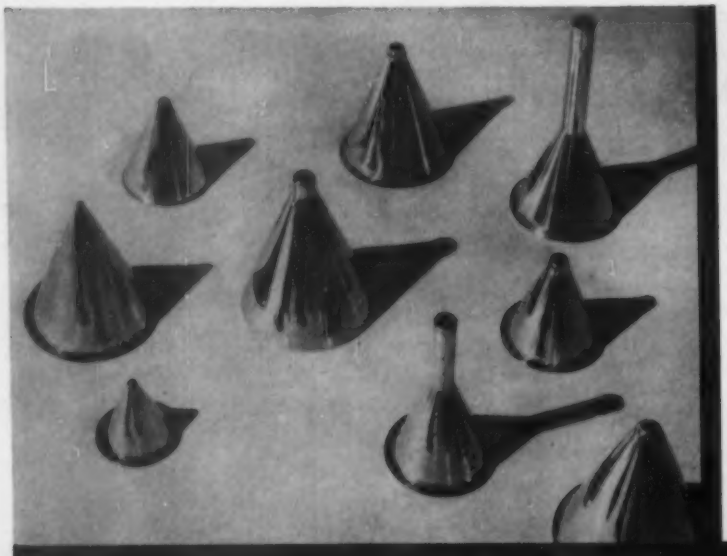
GET THE ANSWER TO YOUR FLEET BATTERY PROBLEMS. THE ULTRA START IS EXIDE'S MIRACLE BATTERY THAT LASTS YEARS LONGER. ULTRA START HAS LASTED MORE THAN 170,000 MILES IN POLICE CAR SERVICE – THAT'S THE EQUIVALENT OF 17 YEARS' NORMAL DRIVING!

WHEN IT'S AN EXIDE, YOU START!

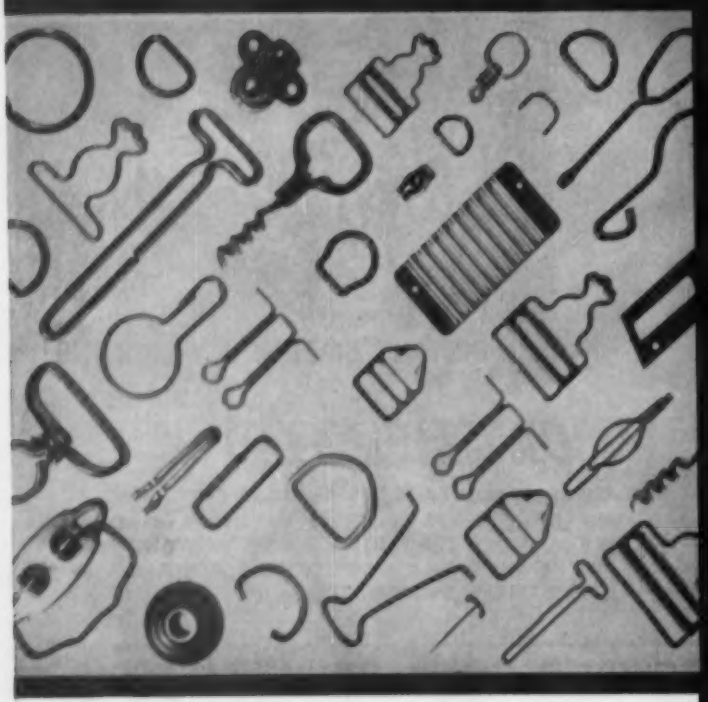




Exide INDUSTRIAL DIVISION, The Electric Storage Battery Company, Philadelphia 2, Pa.



Deep Drawings • Wire Forms • Metal Stampings



For small or medium sized parts and components in a wide variety of metals, finishes and shapes, call on Eastern Tool.

We are completely experienced and equipped for large volume, precision production, including assembling, welding, brazing.

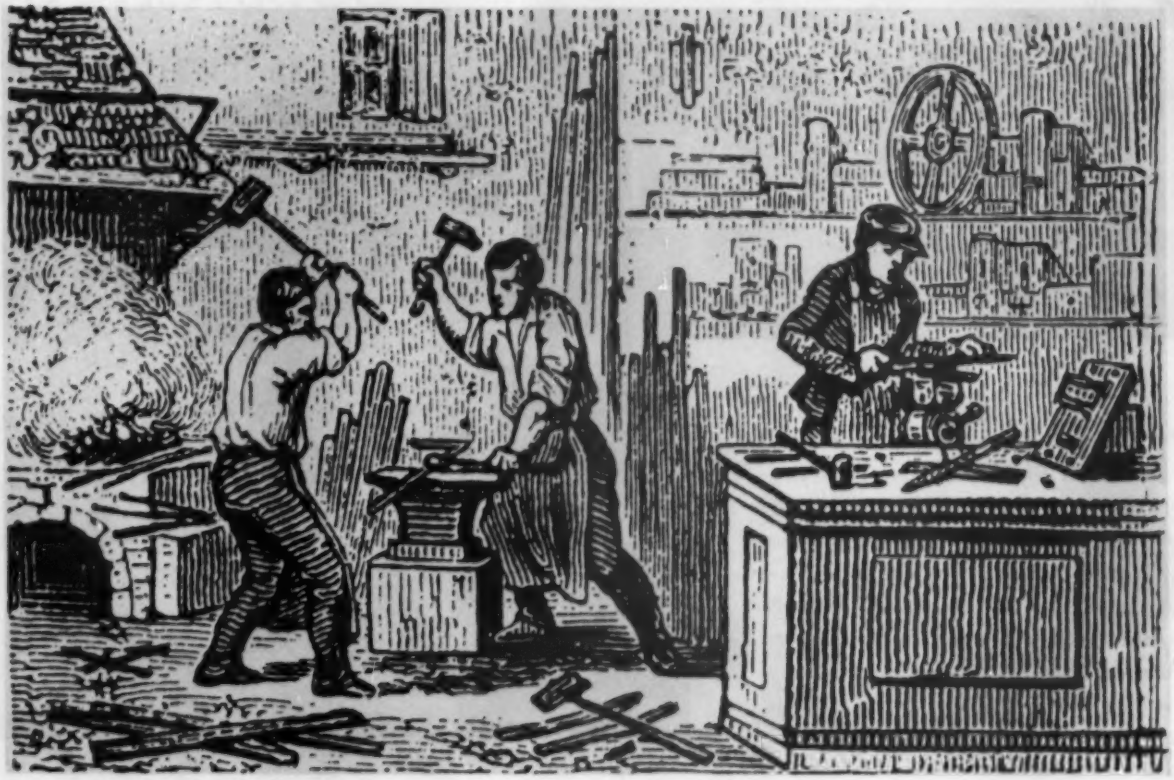
Send us your specifications or blueprints for our quote. Our engineering department is available to suggest design changes that can, in many cases, give you a better product at lower cost.

Write or phone now for Catalog No. 100

Eastern Tool & Mfg. Co.
Belleville 9, N. J.

Telephones:
Belleville: PLymouth 9-7100
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THIS WAS METALWORKING

. . . Houghton helped it "Grow Up"

We've met up with a lot of metalworking problems since we started selling our now-famous "Cosmoline" rust preventives to "blacksmiths" almost ninety years ago. And as the industry grew to its present mammoth stature, the Houghton name became closely allied with many of metalworking's modern operations.

Today Houghton men are called on to share their experience and know-how in solving a wide range of production and processing problems—and they're building a reputation for getting results.

FOR INSTANCE . . .

- Helping to boost machining output by more effective cooling . . .
- Recommending lubrication that stays put under toughest operating conditions . . .
- Meeting high physicals in modern heat treating . . .
- Speeding up metal cleaning at lower costs . . .
- Improving deep drawing at extreme pressures . . .
- Preventing rust from damaging machinery and products . . .
- Increasing the safety of hydraulic operations . . .

. . . and so on through the plant!

Like the venerable *Iron Age*—whose long history of service to metalworking so closely parallels our own—we will meet the industry's growing need for help in solving today's problems—and the future's. For help with *yours*, address Metalworking Department, E. F. Houghton & Co., 303 W. Lehigh Ave., Philadelphia 33, Pa. Or ask the Houghton Man when he calls at your plant.

E F HOUGHTON & CO.

PHILADELPHIA · CHICAGO · DETROIT · SAN FRANCISCO



Ready to give you on-the-job service . . .

HOUGHTON 1001 PRODUCTS TO IMPROVE PROCESSING

McKAY

Specializing in Automatic Steel Processing Machinery

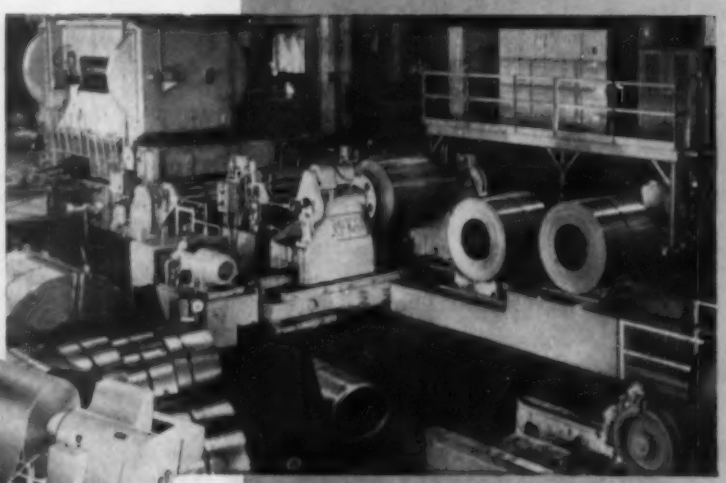
THE NEXT DECADE will see more engineering and technical advancement than we have experienced in the last 25 years. This advancement will be due to the economic pressure on industry to continually reduce manufacturing costs. Cost reduction can only be accomplished by the invention of new processes or the development of new methods or the automation and mechanization of existing machines. Whether you require a single machine or a completely automatic line, you'll be wise to consult McKay, where progressive ideas are backed by 35 years of "on the job" experience.

•

You'll find machines of the types pictured on these pages in current use in plants bearing America's foremost industrial names.

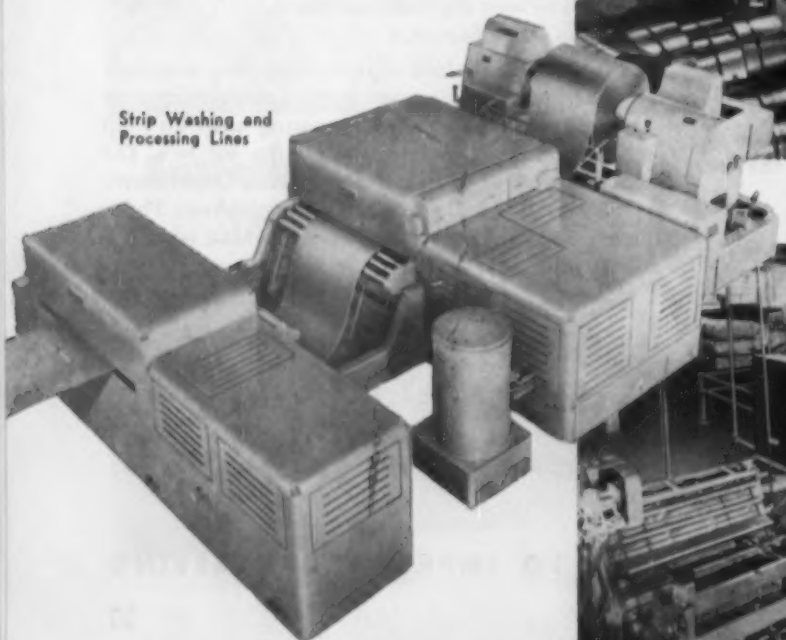


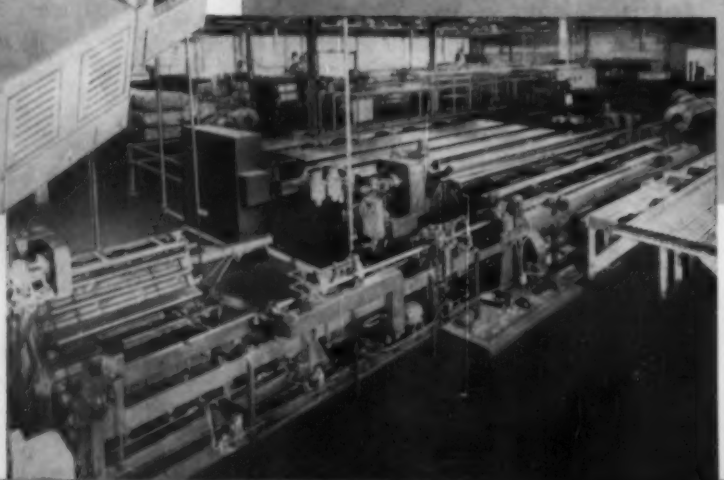
Automatic Cold Draw Lines



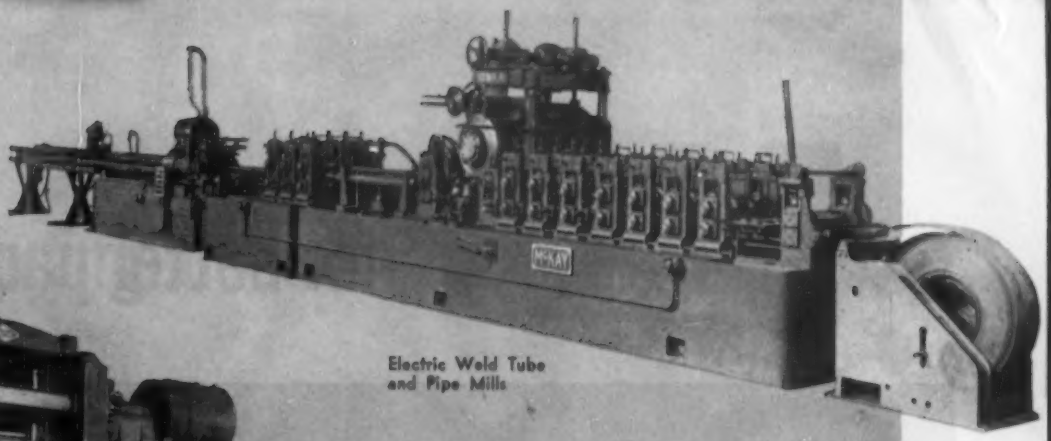
Automatic Press Feed Lines

Strip Washing and Processing Lines

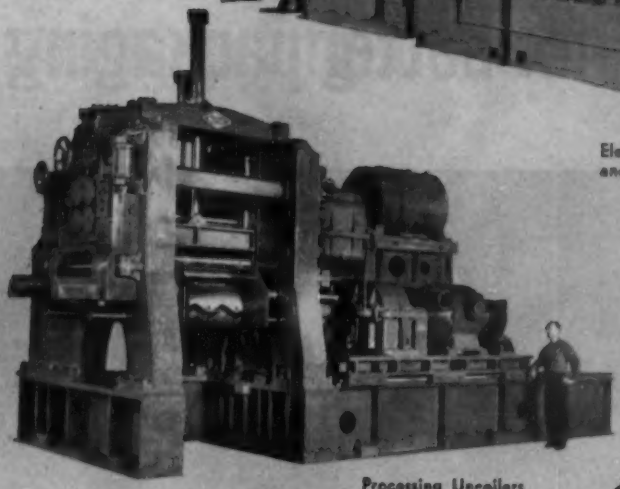




Automatic Tube Cut-Up Lines

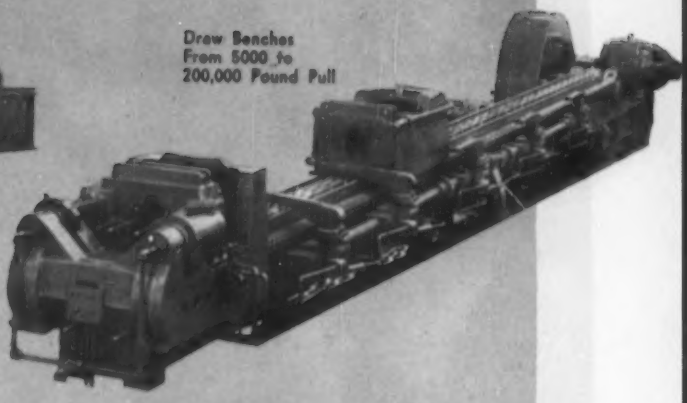


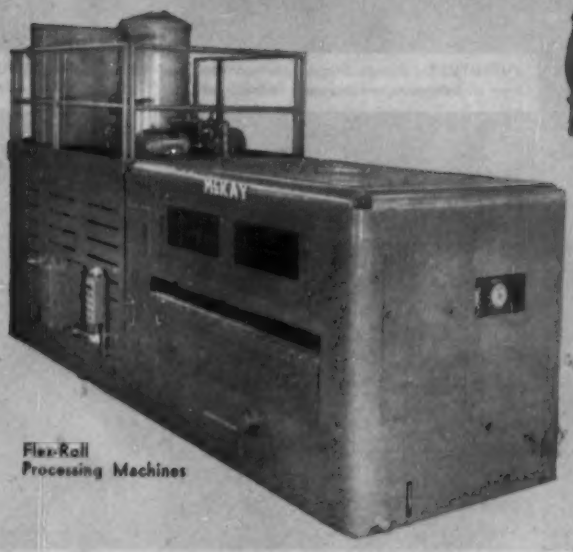
Electric Weld Tube and Pipe Mills



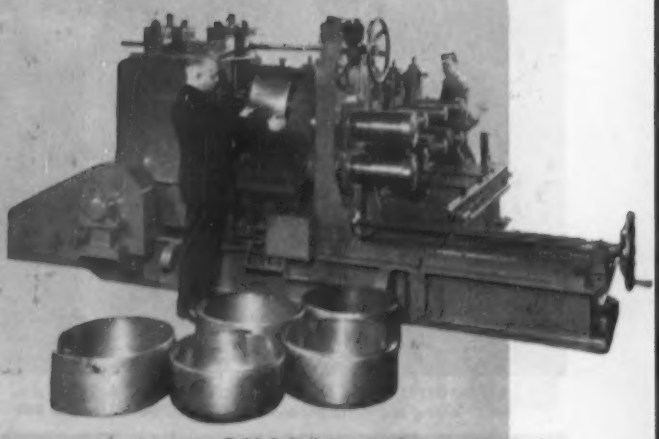
Processing Uncoilers

Draw Benches From 5000 to 200,000 Pound Pull

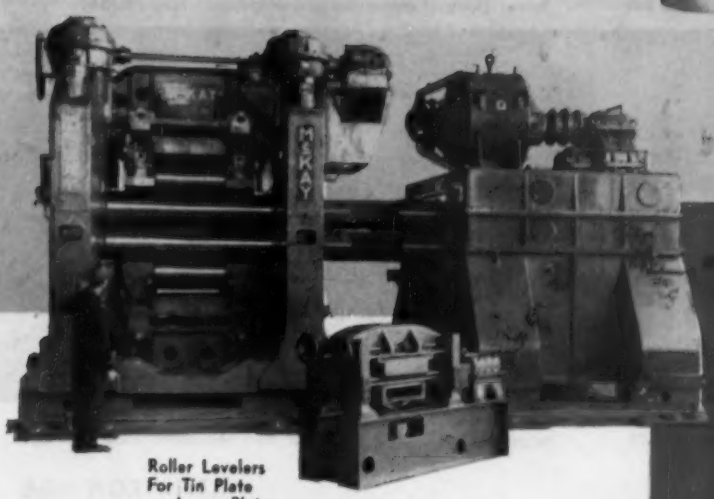




Flex-Roll Processing Machines



Cold Rolled Forming and Circling Machines



Roller Levelers For Tin Plate or Armor Plate

The McKAY MACHINE Company

Youngstown, Ohio

DESIGNERS AND MANUFACTURERS OF EQUIPMENT FOR THE AUTOMOTIVE, FABRICATING AND STEEL INDUSTRIES

AIM* for better packaging



AUTOMOTIVE—Gray iron castings are palletized for truck shipment. Storing and interplant handling are simplified. Idea No. 462.



FURNITURE—This packaging method and Acme Steel Strapping cut time and shipping weights over former crating methods. Idea No. 454.



CONTAINERS—Acme-Morrison Stitcher saves 25% in time over former gluing of corrugated interior packing. Idea No. 460.



METALWORKING—Acme Steel's famous Arcuate wire stitching method guarantees strong, safe closure of fibre boxes. Idea No. 456.



METALWORKING—Cooling blades for diesel intake fans are strapped on pallets with 2 to 4 straps for truck shipments. Idea No. 461.

and shipping ideas like these...and save!



APPLIANCES—Acme Steel methods assure safe transit by securely bracing carload shipments of home freezers. Idea No. 448.



WOODWORKING—Fast, packaging with FI Strapping Machine that automatically cuts, tensions and welds Steelstrap. Idea No. 452.

These Acme Steel Strapping and Wire Stitching *ideas in action* are paying for themselves many times over in low-cost, damage-free shipments and satisfied customers.

Each idea shown here, and hundreds of others, are the result of close cooperation and intelligent application of methods and techniques between an *Acme Idea Man and the shipper.

Acme Steel *ideas in action* can be applied to packaging and shipping problems in virtually every industry. If there are ways to save time, money and materials, your *Acme Idea Man can help you find them.

He's easy to reach. Just call your nearest Acme Steel office—or fill out the coupon below.

ask your *Acme Idea Man

He can help you by...



ANALYZING your present packaging and shipping practices in line with modern systems that reduce costs and assure safe arrival.

DEMONSTRATING in your plant the strapping and stitching equipment best suited for your own products, your plant, your needs.

RECOMMENDING in specific terms the steel strapping or wire stitching methods that will provide the greatest savings to you and your customers.

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ACME STEEL





send for these valuable catalogs on Acme Steel Strapping, Strapping Tools and Wire Stitching equipment. Get the full story on packaging and shipping. Use the coupon.

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Please send me further information on Acme Steel's Safe, Lower-Cost Shipping Methods. I am interested in ☐ Steel Strapping; ☐ Wire Stitching; ☐ having an Acme Idea Man call on me.

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Address_____

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43 YEARS



Left above—Cleveland's advertisement in the 75th Anniversary issue of the IRON AGE in 1930. Right—Cleveland's first full-page advertisement in the IRON AGE, published in the issue of December 11, 1919.

In 1925, Cleveland announced AT type worm gear speed reducer designed for overhung loads. It also introduced the new universally used box-type housing.





CLEVELAND
Worm Gear
Speed Reducers

CLEVELAND HAS BEEN MAKING DEPENDABLE

OF PROGRESS

TWENTY-FIVE years and more have passed since the IRON AGE carried the two advertisements opposite—one in 1919, one in 1930. The messages of those old pages from America's great metal working magazine are just as true in 1955 as they were a generation ago.

Pioneering in the field of worm gearing since its founding in 1912, Cleveland still pioneers. Among developments by Cleveland engineers are these notable firsts:

In 1918, the first standardized line of engineered worm gear speed reducers for industry.

In 1925, the first box-type housing, which provided an improved radiating surface on worm gear reduction units.

In 1925, the first worm gear reduction unit capable of handling overhung loads.

In 1944, the first fan-cooled worm gear speed reducer.

In 1954, the Cleveland Speed Variator.

Through its entire 43 years of operation Cleveland has devoted its engineering and manufacturing facilities uninterruptedly to the production of worm gearing and worm gear speed reducers. With users' needs as our guide, we have concentrated on these tasks—to increase the horsepower capacity of the worm gear drive, to make worm gearing more adaptable to varied industrial requirements, to increase the durability and lifetime economy of worm gear speed reducers, and to make Cleveland synonymous with highest quality and dependability.

It has been 43 years of progress. And with utmost confidence in the future of American business, we pledge Cleveland to continued progress in the years ahead in satisfying the needs of industry for efficient, economical power transmission equipment.

When you install a Cleveland, you can be sure you are investing in the finest, most dependable drive to be had.

The Cleveland Worm & Gear Company, 3285 East 80th Street, Cleveland 4, Ohio.

Affiliate: The Farval Corporation, Centralized Systems of Lubrication. In Canada: Peacock Brothers Limited.



In 1944, Cleveland introduced Speedaire, the first fan-cooled worm gear speed reducer, which made possible delivery of greatly increased horsepower from a unit of given frame size.



In 1954, Cleveland introduced its Speed Variator, employing a radically different principle of speed change and power transmission.

WORM GEAR DRIVES FOR 43 YEARS

"As fundamental in principle as the wheel"

The all metal door with the coiling upward action

Nearly sixty years ago, the wonders of METAL were combined with the principle of the WHEEL — and a new era in door efficiency was born. For this was the beginning of the interlocking steel-slat door, *originated* by Kinnear.

Like the invention of the wheel itself, this new type of door marked a *basic* advance in the story of man's materials and methods. The unsurpassed durability and protection of all-metal construction joined forces with the matchless efficiency of *coiling upward action.*

Today, the Kinnear Rolling Door — featuring those same basic advantages in modern design — is still the choice of leading architects and builders, for industrial, commercial, institutional and governmental buildings.

Kinnear Rolling Doors assure smooth, easy operation that saves time and effort. They help traffic move more efficiently. Their coiling upward action permits full use of all floor and wall space around openings at all times. Materials placed within an inch or two of the steel curtain, *inside or outside,* won't block door operation. When raised, the door clears the entire opening, from jamb to jamb and floor to lintel.

In addition, Kinnear's all-metal construction cuts maintenance costs, gives extra fire protection, defies the elements, bars intruders and resists damage by wind, vehicles or vandals.

Any Kinnear Rolling Door can be equipped for motor operation, with push-button switches at any number of points. The doors are built to any size, for easy installation in old or new buildings. Write for full details.

THE KINNEAR MFG. CO.
Offices and Agents in All Principal Cities

FACTORIES: 1760-80 Fields Ave., Columbus 16, Ohio
1742 Yosemite Avenue, San Francisco 24, California





this little drip costs you money!

On a 10¢-per-gallon product, 6 CC of leakage per minute costs you about $90 per year in unnecessary product waste.

REPLACE PUMP PACKING WITH

BJ mechanical seals

Eliminate unnecessary stuffingbox leakage by installing a BJ Mechanical Seal. You not only realize important savings of pumped products but you also save on repacking and downtime losses. A BJ Mechanical Seal also prevents contamination of the pumped liquid ... protects against volatile and corrosive liquid hazards.



BJ MAKES A COMPLETE LINE OF MECHANICAL SEALS...

BJ makes reliable high-precision seals in material and construction combinations to answer almost any pressure, temperature and liquid requirements. This means that BJ can provide the *one best seal* for each specific pumping need. Ask your nearest BJ sales engineer to show you how Mechanical Seals can save you money. Or you can obtain further information by writing for BJ Bulletin No. 54-1-10,000.

BJ
SINCE 1872

Byron Jackson Co.

PUMP DIVISION

P. O. BOX 2017 TERMINAL ANNEX • LOS ANGELES 54, CALIF.

Sales Offices in Principal Cities



1. **THESE LARGE REELS** of steel wire are manufactured to the exact specifications of the Roto-Rooter Corporation. Here Roto-Rooter employee Glen Anderson operates an electric hoist to transfer a reel of wire to the coil forming machine, where it is formed into one of the various sizes of flexible cable used in the Roto-Rooter machines.



2. **ILLUSTRATED HERE** is the coiling machine which is used to place the bulk cable coming from the coiling machine into the Roto-Rooter machine reels.

"That AS&W wire is really wire!"

says R. A. YOUNG,

Secretary of the Roto-Rooter Corporation, Des Moines, Iowa

"Our business is making machines*—a special sewer and drain-cleaning machine called the Roto-Rooter. Strict specifications are followed in the manufacture of the Roto-Rooter, especially in the flexible steel cable which is the heart of the machine. That cable must be really tough—strong enough to withstand the acute twisting action of the revolving reel, flexible enough to negotiate the sharpest bends and turns, highly resistant to the corrosive elements found in all sewers. That cable absorbs a terrific beating, and naturally it must be fabricated from an especially high grade steel wire.

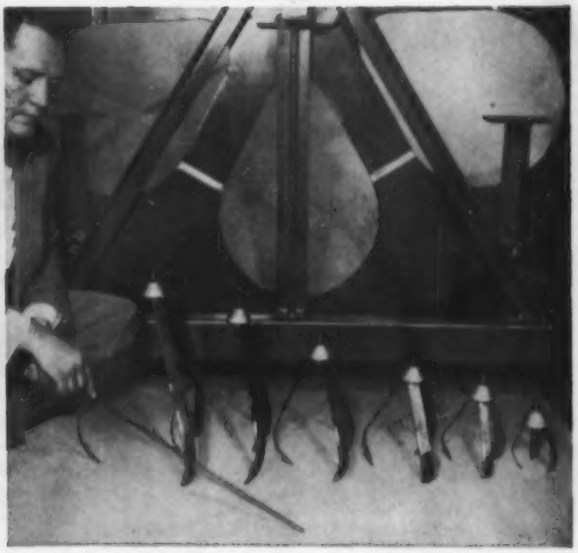
"We found the kind of wire we need at American Steel & Wire. Our engineers got together with the AS&W metallurgists, working out the heat treating and hardness specifications. The wire we get from AS&W is made especially for us, and is not used by any other manufacturer. One of the things we like best about AS&W is their constant adherence to our close-tolerance specifications. And we're more than satisfied with the terrific performance of the steel wire in our machines. That AS&W wire is *really* wire!"

The experience of the Roto-Rooter Corporation is not unusual. Thousands of manufacturers all over the country have learned to depend on the consistently high quality of USS American Manufacturers Wire. A better-grade steel wire enables you to do a better fabricating job . . . and often saves you money, too.

American Steel & Wire carries, *in stock*, over 400 different types of American Manufacturers Wire, including Stainless, for you to choose from. For special requirements, our trained staff will work with you to develop a new wire that will meet your specifications exactly. Why not let us help you with *your* steel wire problems? If you make it of wire, make it of the best—USS American Manufacturers Wire.



3. EMPLOYEE J. B. THOMAS is shown attaching the steel cutting blades to flexible steel cable on the Roto-Rooter machine. The revolving reel shown on the right housed 120' of this ¾" AS&W steel cable. In the background can be seen the stockpile of finished cables ready for installation in the machine.



4. N. W. LARSEN of the Roto-Rooter Corporation shows the various sizes of Roto-Rooter cutting blades. In operation, the blades are attached to the end of the flexible cable and receive their cutting motion from the revolving reel at the opposite end through the steel cable.

5. AND HERE'S a finished Roto-Rooter in operation with the cutting blades about to be inserted into the sewer line. The razor sharp, high-speed rotating blades cut all roots, grease, scale, and other debris into tiny pieces, leaving the line as clean as the day it was installed. The specially-designed steel cable has to absorb a terrific beating in negotiating the sharp turns and bends found in domestic sewer lines—as high as four or five 90° turns in one operation. It's easy to see why the Roto-Rooter Corporation insists on the highest standards of quality in the steel wire they use in these cables . . . and why they use American Manufacturers Wire exclusively.

*Roto-Rooter is a nationwide sewer service and Roto-Rooter machines are placed only on an exclusive franchise basis.



If you make it of wire...
make it of the best!

U S S AMERICAN MANUFACTURERS WIRE

AMERICAN MANUFACTURERS WIRE

AMERFINE—*High-quality fine wire.*

AMERSPRING—*music steel spring wire.*

AMERLOY—*alloy heading wire.*

AMERTEMP—*heavy-duty oil-tempered wire.*

AMERHEAD—*uniform heading wire.*

AMERSTITCH—*extra-tough metal stitching wire.*

USS

AMERICAN STEEL & WIRE DIVISION, UNITED STATES STEEL CORPORATION, GENERAL OFFICES: CLEVELAND, OHIO
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA., SOUTHERN DISTRIBUTORS • UNITED STATES STEEL EXPORT COMPANY, NEW YORK

UNITED STATES STEEL



stainless steels are thoroughbred, too

The experienced exhibitor rents extra stalls... leaves them empty... to prevent contamination of his thoroughbred pets by canine neighbors.

To develop their best qualities demands *exclusive* care. That is why Sun Ship's new Alloy Products Shop has been planned for the *exclusive* fabrication of stainless and alloy steel products. When you have selected from the many available Alloys a stainless steel best suited for your service condition, you have done only half the job. You must also provide for the best possible fabrication if you are to have full protection—"A Thoroughbred Job."

Why entrust stainless steel to be fabricated in the same shop where carbon steel products are fabricated, and subject this precious metal to contamination with iron fragments, dust, or other harmful elements? A segregated shop is your answer.

Sun Ship now operates an all-alloy shop, one especially built and equipped for fabricating stainless and alloy products as they should be—segregated from carbon steel fabrication.

We emphasize the fabrication of medium and heavy stainless, alloy and aluminum products for industry.

Try Sun Ship for stainless fabrication as it should be done.

Our Sales Engineering Department will be pleased to assist you with any of your fabrication problems.

Sun Ship also makes all types of carbon steel pressure vessels.

ALLOY PRODUCTS SHOP

OF Sun SHIPBUILDING & DRY DOCK COMPANY

ON THE DELAWARE • CHESTER, PA. • 25 BROADWAY, NEW YORK CITY



now!

EMBOSSED STEEL

for cabinets, panels, trim

helps you meet the new demand for color and texture!

- sheets and coils up to 48 inches wide
- Scratch-free—eliminates rejects, one coat of paint
- 25% stronger—lighter gauges do the job
- patterns tailored to any product
- permanent patterns—unaffected by stamping, crimping, hold-down shears

up to 48" wide

You no longer need be "stumped" by the rapidly growing demand for color and 3-dimensional texture in all kinds of products. SUN 3-D STEEL, with exciting embossed patterns in mild carbon steel, stainless steel, or aluminum, is now available!

Widths up to 48 inches make SUN 3-D STEEL applicable to every product. Act *now*—get ahead of competition with SUN 3-D STEEL!

SEND FOR THIS *Colorful* BROCHURE



SUN STEEL COMPANY

1680-1700 WEST 74th PLACE, CHICAGO 36, ILLINOIS

SUN STEEL COMPANY, Chicago 36, Ill.

Please send at once the brochure on SUN 3-D STEEL, giving full details, applications, fabrication advantages.

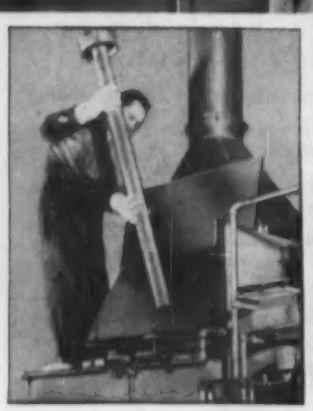
Name_____ Title_____

Company_____

Address_____

City_____ Zone_____ State_____

MORE FURNACE VERSATILITY



Lindberg radiant tube is easy to change. Just turn off furnace, lift old tube out and put in new tube.

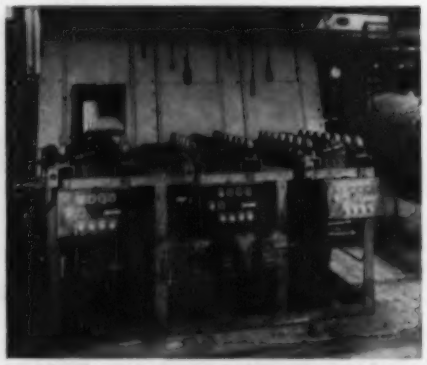
These are two of the three Lindberg gas-fired radiant tube carburizing and carbonitriding furnaces recently installed by an internationally known maker of farm machinery. With these furnaces 75% of parts are carbonitrided and 25% carburized. In addition, some bright annealing is done and the versatile Lindberg units can easily be converted for other heat treating applications.

Lindberg Vertical Radiant Tube Great Advance in Heat Treating Furnaces

When metal needs heat, Lindberg furnaces with the new Lindberg lightweight vertical radiant tube offer a better way to apply it. Industry the world over is finding that Lindberg furnaces with this new vertical tube provide a versatility no other type of furnace can give. Carbonitriding, carburizing, carbon restoration, bright hardening or annealing and normalizing are all possible with only minor adjustments.

Here are some other exclusive advantages. Lindberg furnaces include a built-in pitless quench tank. Uniform case depth is assured because each charge automatically remains at heat the same length of time. A built-in purge chamber receives work loads for purging prior to heating.

Whatever type of furnace fits your production needs, from gigantic continuous pusher-type to the small manual batch-type furnace, Lindberg engineers can develop exactly the right equipment for you.



This three-row pusher Carburizer, with vertical radiant tubes between each row, was built for a large automobile manufacturer.

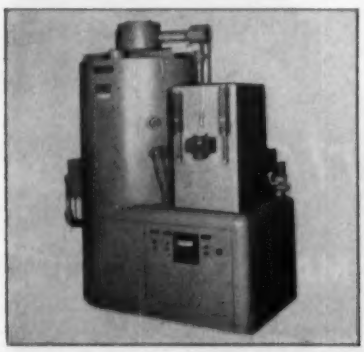
WITH LINDBERG RADIANT TUBES



Here you can see the unique "dimpled" design of the new Lindberg vertical radiant tube. Installation is a Lindberg continuous pusher-type gas-fired carbonitriding furnace.

Revolutionary new development

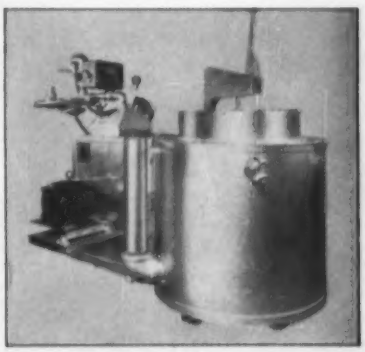
The development by Lindberg of the lightweight, easily-changeable vertical radiant tube (patent pending) is one of the most significant improvements ever made in industrial furnace design. It eliminates the bulk and bend problems of the old-fashioned horizontal tube and the uneven heat patterns inherent in earlier vertical tubes. The secret lies in the new Lindberg tube's "dimples". Here's how they work—in the radiant tube a central stream of mixed air-and-gas is surrounded by a cylindrical stream of air alone and combustion occurs in the area between these two streams. The "dimples" create eddies in the streams accelerating combustion and maintaining even temperatures along the entire length of the tube. If you aren't fully familiar with this revolutionary development ask us, or your nearest Lindberg Field Engineer about it.



This newly-designed Lindberg Hyen generator is used with Lindberg radiant tube furnaces to supply the most exacting atmospheres needed for any heat treatment.

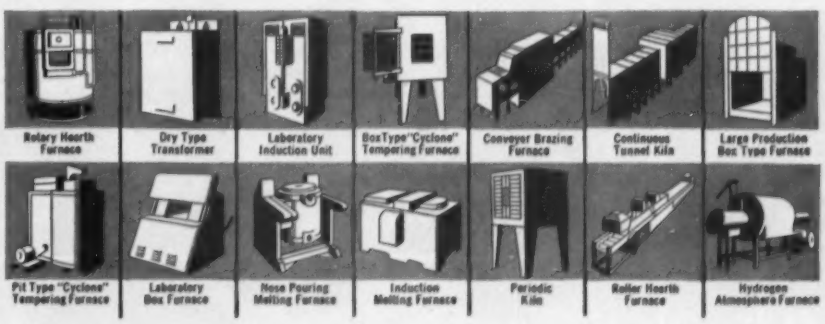


Here is the new Lindberg Carbotrol unit which automatically controls the carbon potential of furnace atmospheres provided by the Lindberg Hyen generator.



For the final step in heat treating, the famous Lindberg cyclone tempering furnace, for 20 years the standard of furnace performance. Pit or box type available.

Lindberg manufactures many kinds of equipment in the industrial heating and related fields. A few of these are symbolized here. If you are interested in any of these please write us for the specifics on them, or get in touch with your nearest Lindberg Field Engineer. (See your classified telephone book.)



LINDBERG ENGINEERING COMPANY

2452 West Hubbard Street, Chicago 12, Illinois

Los Angeles Plant: 11937 South Regentview Avenue, at Downey, California • **Associate Companies:** Lindberg Industrial Corporation, Chicago • EFCO-Lindberg, Ltd., Montreal, Canada • Lindberg Italiana, Milan, Italy • The Electric Furnace Company, Ltd., Weybridge, Surrey, England • Etablissements Jean Aubé, Paris, France • Lindberg Industrie Ofenbau, Gross Auheim, Germany

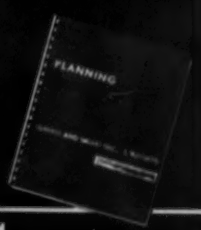


Experience is important

. . . IN PLANNING YOUR AUTOMATED PLANT

AUTOMATION has been engineered into Giffels & Vallet projects for many years. Although it was then not identified as Automation by name, it *did* produce automatic operations of many types. Automatic shakeouts in foundries—automatic stackers in board plants—automatic surge storage between machines—and many other applications throughout industry.

Automation is but one phase of the comprehensive planning and engineering services provided by Giffels & Vallet. Rubber, Plastics, Metalworking and Cement—these are but a few of the widely diversified industries Giffels & Vallet is serving. These services are discussed in a special Planning Brochure, and a copy will be mailed upon request.



Engineers serving Industry for over 30 Years

INDUSTRIAL ENGINEERING DIVISION

NEW YORK
CHICAGO
HOUSTON
WINDSOR, ONT.

Giffels & Vallet INC.

DETROIT, MICHIGAN

VITRIFIED WHEEL COMPANY

ESTABLISHED 1865

90 years in the Grinding Wheel Business

Congratulates 100 year old *IronAge*

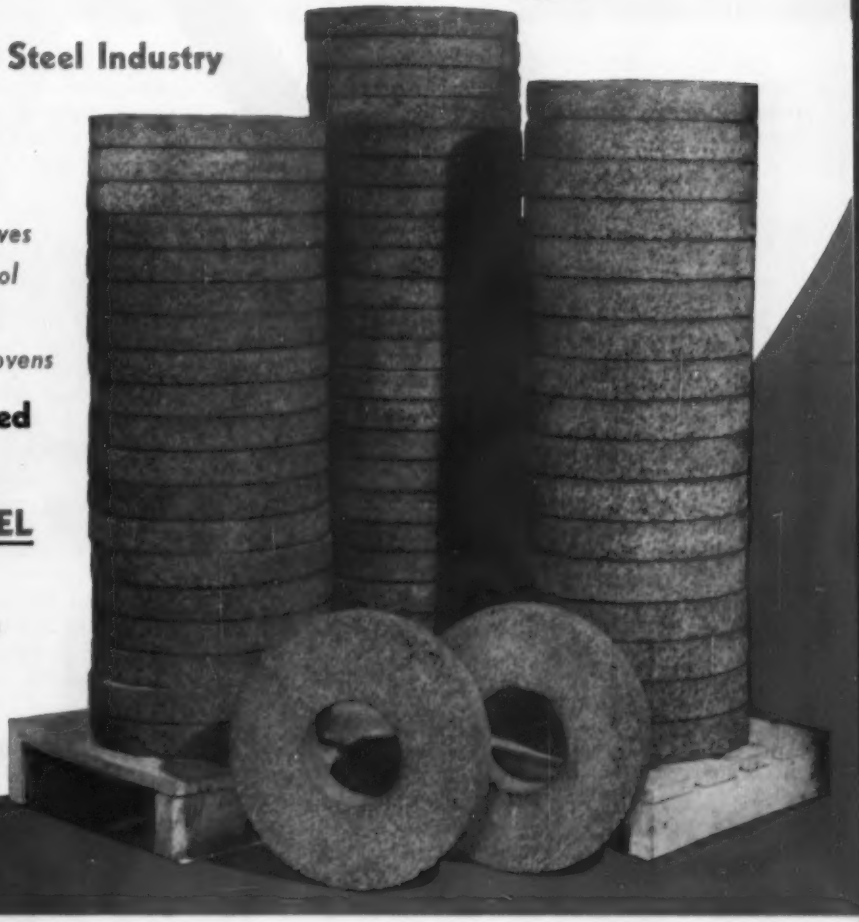
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Commencing our second century, we will continue to supply the right standard or special fasteners...with even better service...to make it a pleasure for you to do business with Buffalo Bolt. We invite you and your distributors to use our service organization...in field and factory...to obtain fast, accurate information on prices, deliveries and other data. Let us serve you...and show you on your next order.

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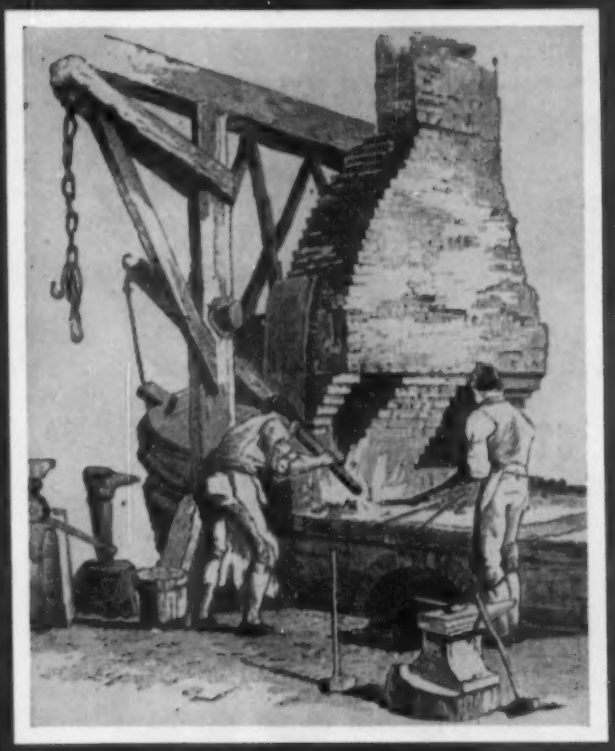
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Founded 1855



166 YEARS AGO, Peter Tarr, iron pioneer, recognized the industrial advantages of what is now Weirton, West Virginia. With raw materials from the surrounding hills, he operated an iron furnace—and a forge like the one pictured.



46 YEARS AGO last April, land was purchased by Ernest T. Weir and associates to construct a new mill. It grew out of a wheat field, with the nearby Ohio River giving easy and economical access to raw materials and providing an unlimited water supply.

WEIRTON STEEL COMPANY

NATIONAL STEEL CORPORATION



143 YEARS AGO, in the War of 1812, Commodore Perry used cannon balls fashioned in what is now Weirton to blast the British Fleet off Lake Erie. His famous victory at Put-in-Bay won for us the Great Lakes.



TODAY—A completely integrated steel mill operates in this fabulous steel town spreading from the Ohio River to the Pennsylvania line. This is the modern Weirton Steel Company with every modern facility for producing better steel of all types.



MORE THAN

100 years of file making ...and still pioneering





Heller files, the first manufactured in America, have met the growing demand for precision tools from the early American blacksmiths to the modern jet age. Through the years, Heller's continual research, mechanization and selection of special-analysis steels has resulted in files that work faster, more efficiently, and give longer service life.

Heller's impressive list of "file firsts" include the unique "wavy-teeth" design in the NUCUT file—the VIXEN milled curved-tooth files—and the spiral-cut half-round files. Heller also manufactures a complete line of Swiss Pattern and Rotary Files.

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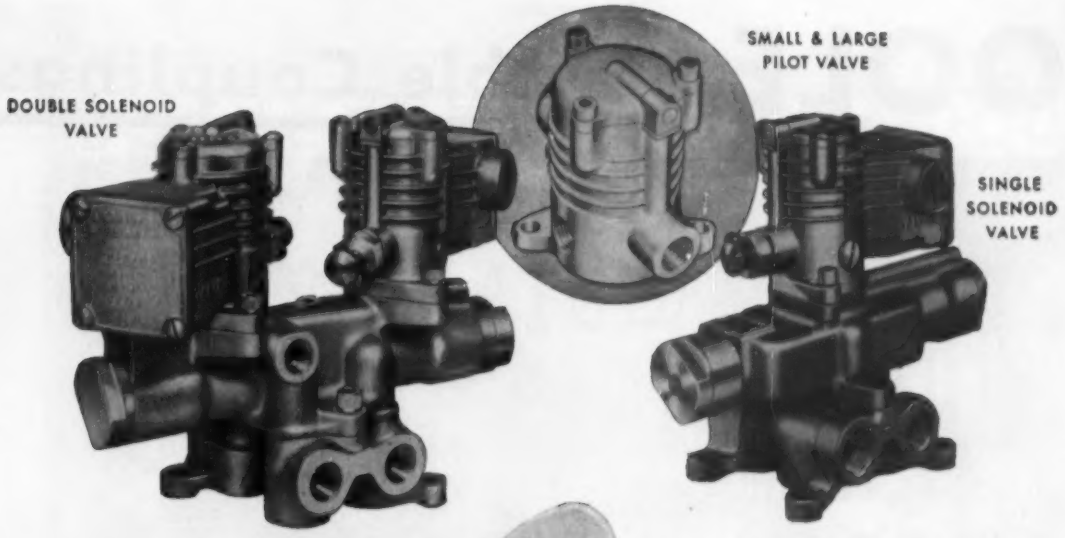
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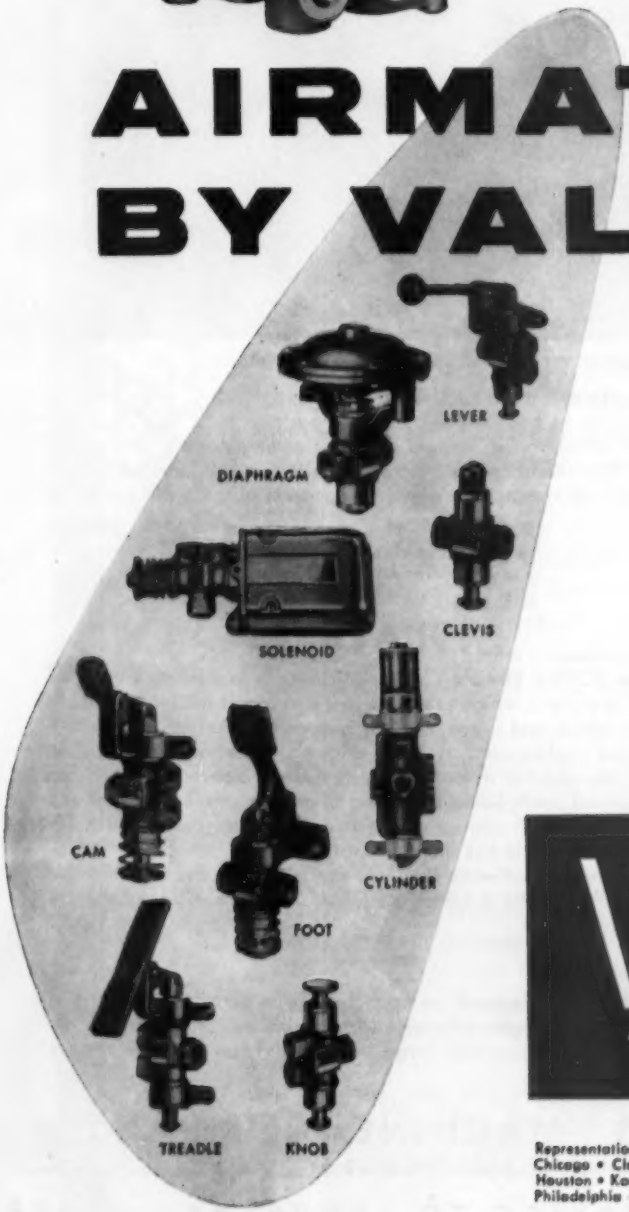
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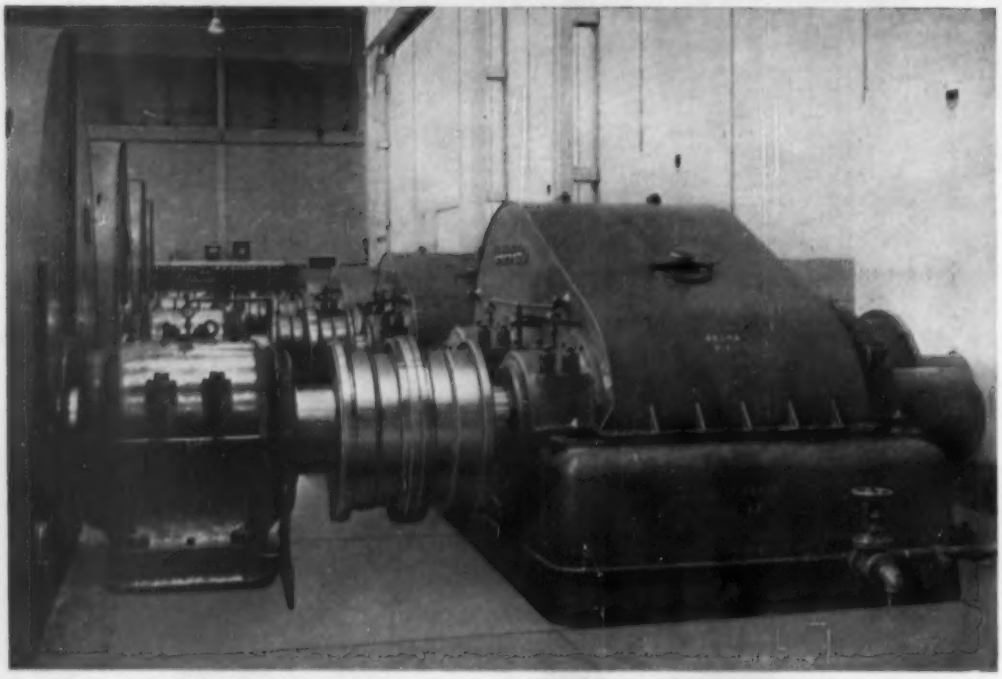
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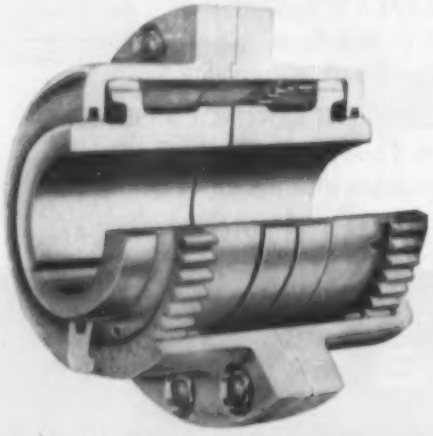
POOLE Flexible Couplings



5,000 H.P. steel mill drives equipped with POOLE FLEXIBLE COUPLINGS.

Look at these features—many of them exclusive with the patented POOLE:
Adjusts itself to all conditions, leaving its members free to float without strain to parts.
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Get the whole story from our handbook, "Flexible Couplings." A copy will be sent gladly without obligation.



FEATURES

The POOLE Flexible Coupling is simple in design, composed of few parts, which are easy to assemble. It has no springs to crystallize and break, and no pins or bushings to require frequent replacement. It is self-aligning, with no binding action at any point of its revolution, its floating sleeves supported on crowned teeth being as free to align themselves as a ball and socket joint. It can be used on reversing service without noise or vibration. It has more strength than the connecting shafts. This means that when the shaft size is correct, the coupling can be ordered to suit the shaft, regardless of load, speeds or utility factors.

The POOLE Flexible Coupling is especially suited for high speeds as each half is in perfect balance and concentrically supported on its own shaft. It presents a smooth exterior surface with no protruding parts. Bolt heads and nuts are fully protected. Its rugged construction with large bearing surfaces make it equally desirable for heavy duty, slow speed drives.

POOLE FOUNDRY & MACHINE COMPANY
1700 UNION AVE., BALTIMORE 11, MD.

1842 — *113 YEARS OF SERVICE TO INDUSTRY* — 1955

CONGRATULATIONS
to Another
OLD TIMER

Just four years ago Hendrick Manufacturing Company celebrated its 75th Anniversary . . . marking three-quarters of a century of service *in* the metalworking industry. We can well imagine the pride of accomplishment Iron Age must feel as it begins its 101st year of service *to* the metalworking industry.

Like Iron Age, Hendrick, too, has achieved tremendous growth since the days it was founded. Today the Hendrick Manufacturing Company perforates metal, rubber, plastics and masonite for hundreds of screening, straining, decorative, display and acoustical applications. We have sales offices in 28 principal cities. While Hendrick serves 90% of the 100 largest manufacturing companies in the United States, we maintain the same high quality standards when serving our thousands of other smaller customers. Our customers represent the widest range of industrial diversity . . . Hendrick serves every one of the 21 basic industries designated by the U. S. Department of Commerce.

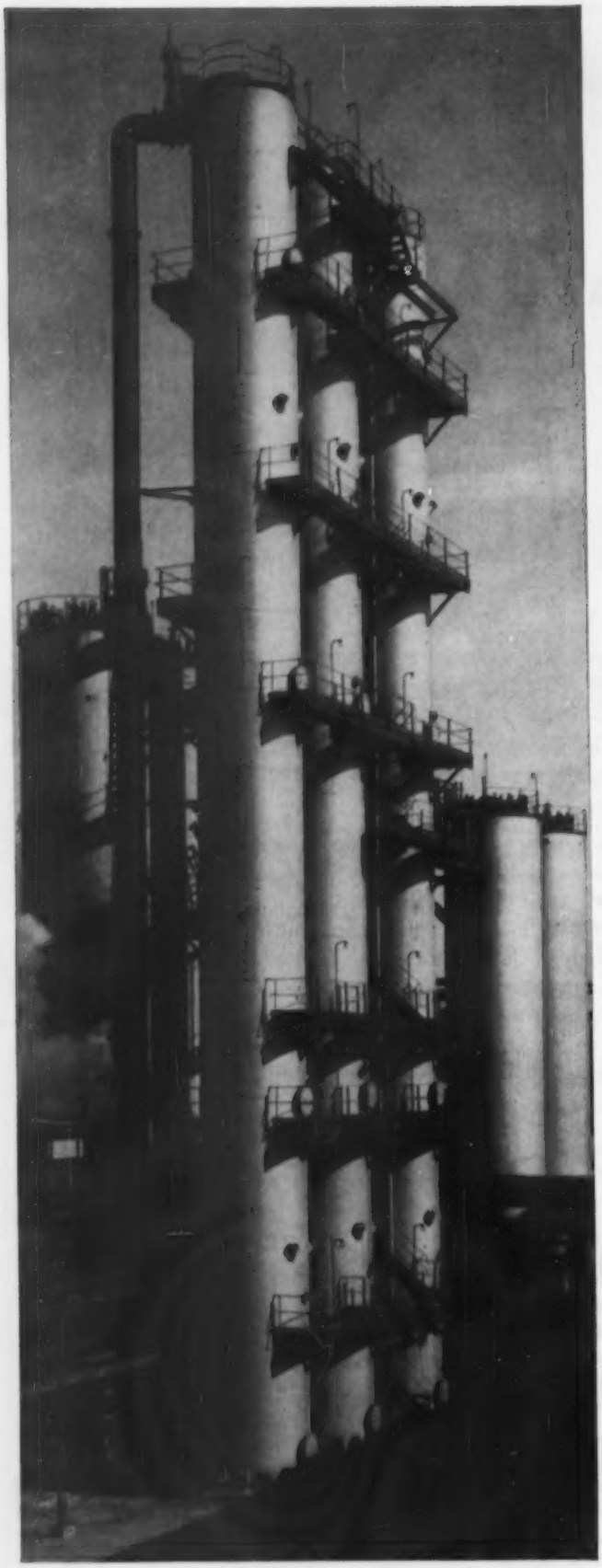
Hendrick joins all the other old timers of the metalworking industry to salute and honor Iron Age on this anniversary of its first century of progress.

HENDRICK MANUFACTURING COMPANY

37 Dundaff Street, Carbondale, Pa.

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Architectural Grilles • Mitco Open Steel Flooring • Shur-Site Treads • Armorgrids



GRAVER

Gas and Chemical "scrubbers" for Great Lakes Steel

(DIVISION OF NATIONAL STEEL CORPORATION)

At Great Lakes Steel Corporation's Blast Furnace Division, a new by-product coke plant is equipped with a total of 25 large examples of Graver's craftsmanship in steel.

These structures, shop-fabricated at Graver's East Chicago plant and field-erected on the site by Graver crews, were built to the designs of Wilputte Coke Oven Division, Allied Chemical & Dye Corporation. These include bins, stacks, gas coolers, tanks for chemical feed, storage, and settling—and scrubbers such as the three 132′ towers shown at the left.

This variety of quality fabrication indicates Graver's versatile craftsmanship—demonstrates Graver's ability to shop-fabricate and field-erect structures for the steel, petroleum and chemical industries. For process and storage equipment in steels, alloys or clads, Graver's offices across the country are staffed with competent engineers ready to serve you.

GRAVER ...craftsmen in carbon, stainless and alloy steels

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Typical "ground all over" series 1600 "precision" bearing.



Typical "unground" series 3000 "precision type" bearing.

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BALL BEARINGS

Yes, the bearings illustrated *are* identical, *except* for degree of precision. Because of the precision differences, there is a substantial difference in cost . . . NICE can provide bearings incorporating any degree or combination of precision features between the higher priced "ground all over" series 1600 and the low cost "unground" series 3000.

The specific requirements of your particular application should determine the precision features of the bearing you use. WHAT PRICE ARE YOU PAYING FOR PRECISION? ARE YOU BUYING MORE PRECISION THAN YOUR BEARING APPLICATION REQUIRES?

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NICE BALL BEARING CO.
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TIN, STEEL, COPPER, ALUMINUM, BRONZE, BRASS, ZINC, ANY METAL, ANY PURPOSE

CHARLES MUNDT & SONS

50 FAIRMOUNT AVE. JERSEY CITY, N. J.

QUOTES: 1855—1955

Production of Rails—1849-1872

The total number of net tons of rails made in the United States in 1872, as reported to the office of the American Iron and Steel Association by the makers, is 941,992, or 841,064 gross tons.

This aggregate of production includes only such rails as were made for the use of freight and passenger railways, and excludes 15,000 tons of street rails and all mining rails.

Years	Total Rails Made in U. S. Tons of 2000 lbs.	Total Rails Imported. Tons of 2000 lbs.	Total Consumption of Iron & Steel Rails	Miles of Railroad Built in United States in Each Year
1849	24,318	69,163	93,181	1,369
1850	44,083	159,680	203,163	1,656
1851	50,603	226,350	276,953	1,961
1852	62,478	294,750	357,228	1,926
1853	87,864	358,794	446,658	2,452
1854	108,016	339,439	447,455	1,360
1855	138,674	153,019	264,693	1,654
1856	180,018	186,594	366,612	3,643
1857	161,918	215,166	377,084	2,491
1858	163,712	90,894	254,606	2,460
1859	195,454	83,058	279,412	1,821
1860	205,038	146,610	351,648	1,846
1861	187,818	89,388	277,206	621
1862	213,912	10,186	224,098	864
1863	275,768	20,506	296,274	1,050
1864	335,369	142,457	477,826	738
1865	356,292	63,327	419,619	1,277
1866	430,778	117,878	548,656	1,832
1867	462,108	184,840	646,948	2,227
1868	506,714	300,160	806,874	3,033
1869	593,586	336,500	930,086	4,977
1870	620,000	472,403	1,092,403	6,145
1871	775,733	566,202	1,341,935	7,453
1872	941,992	530,850	1,472,842	6,043

May 15, 1873

Crystallization In "El" Studied

The elevated railroad managers of New York recently spoke of a "depreciation of material" as a reason for an abatement in taxable values, and this plea was quickly availed of by certain theorists in support of the allegation that crystallization of the metal threatened speedy destruction to the entire elevated system.

As if to combat injurious reflections, an inspection of the structures of the elevated railroad companies was recently made by several prominent railroad and bridge engineers, on the invitation of the officers of the Manhattan Railway Company. The reports are understood to be favorable without exception.

No Weakness Found

"So far as any question of the deterioration of material is concerned through so-called crystallization, which would endanger their safety for the traveling public, no such fear need be entertained.

"In all our experience, which has extended over many years, with structures submitted to heavy and continuous use under at times excessive conditions, we have never found any evidence to show that iron becomes crystalline or weak under service, if not strained beyond limits, which the calculations show have not been exceeded or approached in the case of your structures.

Continuous Inspection

"We have inspected the structures, and we find them safe for existing traffic. We, however, deem it important that the improvements and additions now being carried out should be continued to completion. We see no occasion for any anxiety on the part of the public as to the safety of the elevated structures, in view of the very thorough inspection continuously maintained over them, through which any defects are at once made manifest long before they could assume dangerous proportions."

Mar. 12, 1885

Novel Metal File

At a recent meeting of the Royal Scottish Society of Arts, Mr. J. Kirkwood, of Edinburgh, described a new file for soft metals and wood. This tool is formed of about 200 separate pieces of steel, connected by an iron bar, which is passed through and bound together by a screw. The advantage claimed for the file is that filings of soft metal of wood can be got rid of by simply loosening the screw and thereby separating the plates, this being done with very little delay or inconvenience. Each file will, it is said, last three years, outwearing 30 dozen ordinary files.

Apr. 1, 1880

Here it is--the sensational new

HOLMES Combination HYDRAULIC FORCING and STRAIGHTENING PRESS



Two Machines In One--Multiple Use... Remarkable Versatility...Ready Adaptability...Low Initial Cost.

In practically any metal fabricating operation, this much-talked-about new press will save time, labor, and material--and pay for itself in a hurry. And no wonder, just check these five major exclusive features:

- ★ QUICK-CHANGE TABLES--enable one press to do both forcing and straightening.
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- ★ O-RING GASKET-MOUNTED VALVES--no pipes. Oil flows through manifold plate.
- ★ SWING-OUT MOTOR AND PUMP PANEL--easy accessibility, maintenance, service.
- ★ ADJUSTABLE ILLUMINATION--frosted incandescent tube lights whole work area.

If you're interested in increasing output...and... cutting costs--why not get ALL the details on the new Holmes Combination Hydraulic Forcing and Straightening Press? Write for Specifications Manual--TODAY. It's yours for the asking--with no obligation whatever.

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Bayley

76 years of participation in the design, use and fabrication of metals in the building field...

BAYLEY'S wide range of experience

Structural steel, bridges, buildings. **1879**

Bridge railings  New York under Roebling. **1900**

1890



Ornamental iron fences for parks, estates. Fire escapes. Bronze windows.

Steel windows. First glazing springs. Steel doors. **1906**



Steel silos — sheet metal fabrication. **1910**

First modern design in steel windows. Flat faces, parallel contacts. Forerunner of today's quality windows. Double glazing. **1912**



1915 Galvanized windows.

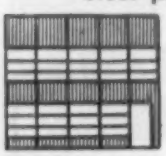
Mechanical operators; (1923—electrically controlled). **1916**

1918 Wrought iron windows. War production; steel windows, screw posts.

Window inserts for concrete buildings. **1920**

Steel projected windows. **1923**

1925 Aluminum projected windows; insect screens.



First curtain wall design in steel. **1928**

1929  Guard windows for prisons.

Bomb shelter doors. Recoil mechanisms for anti-aircraft guns. Hangars, USAF. **1941**

1940 Steel detention awning projected windows. Doors for liberty ships.



1950 Steel detention curtain wall systems; 1954—Aluminum.

Bomb Shackle releases—USAF. **1953**

1955 Steel intermediate projected windows.





Agents in All Principal Cities

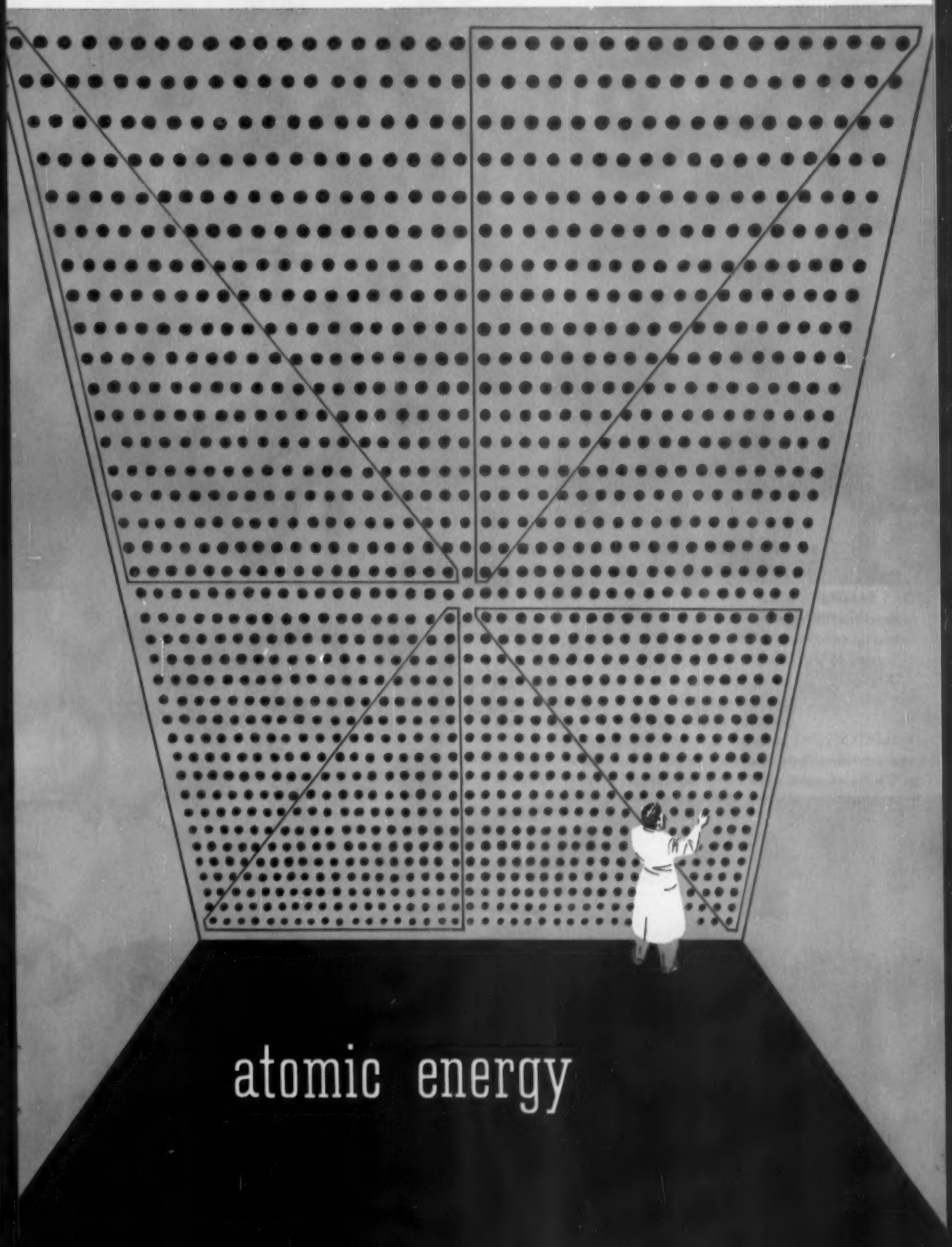
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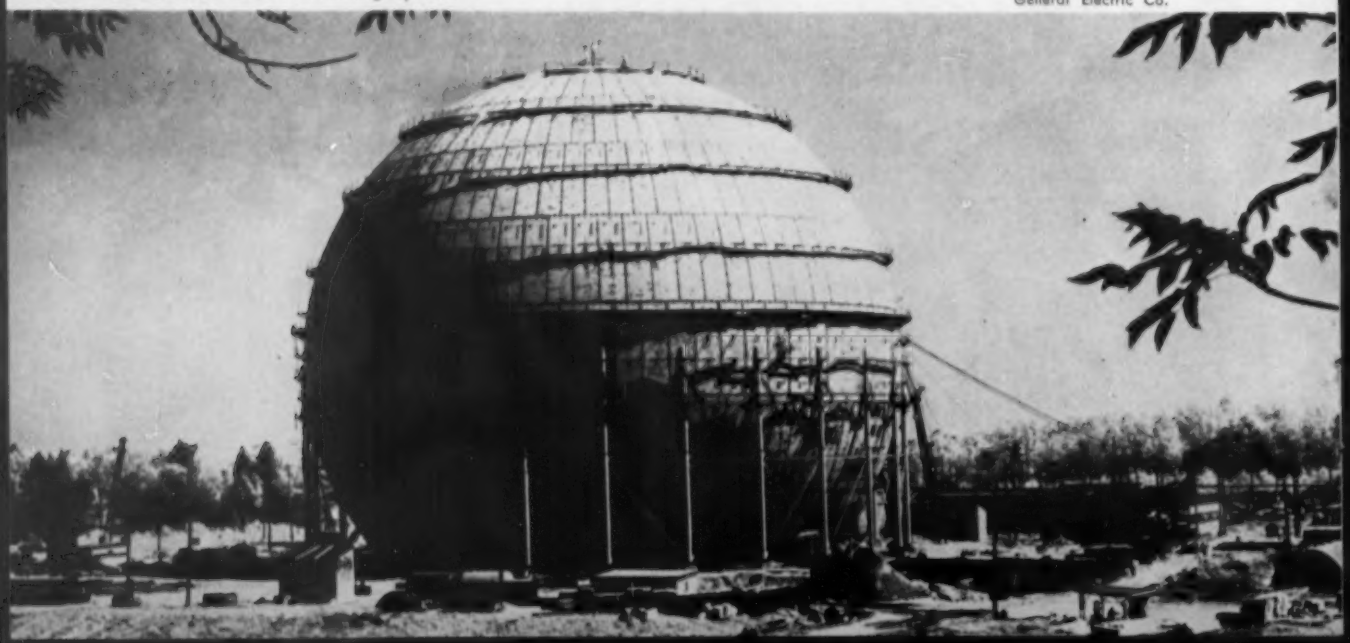
GAS SAMPLE is taken in experimental foundry following addition of tracers to steel heat.

Ford Motor Co.

ATOMIC ENERGY...

WELDED SPHERE houses new submarine type reactor. Its 5 miles of welds were all radiographed.

General Electric Co.





IN A SQUASH court at the University of Chicago on Dec. 2, 1942, man first originated and controlled a nuclear reaction. The architect of the atomic age was the late Dr. Enrico Fermi, who directed the physicists who there achieved the fission of uranium. Two years previously the U. S. government had appropriated $6000 for studies of nuclear fission; since then the total U. S. atomic energy bill has passed $14 billion.

Distribution of radioisotopes from the Oak Ridge reactor began in the summer of 1946. Shipments have soared from 250 during that year to over 11,000 (some $30 million worth) in 1954. They now save industry an estimated $100 million a year.

The metalworking industry's interest in the atomic energy field falls into three categories: Radioisotopes as tracers or sources; nuclear power; and metals and equipment.

Typical tracer applications include: Checking engine wear by irradiating piston rings reduced a potential million dollar research project to a $35,000 job; one company uses small quantities in solution on blotting paper in a pneumatic tube message handling system, can quickly detect stoppages in lines with a Geiger counter; Ford Motor Co. had 5 lb of iron ore fines irradiated at Oak Ridge, mixed them with 76 tons of fines and ore and charged it into a blast furnace. Radioactivity check showed only 40 pct of the fines were lost—less than anticipated but still uneconomical.

Radioisotope sources are used for measuring and for inspection (radiography). Beta gages use radioactive sources like strontium to measure up to about 1/16 in. in aluminum, 1/32 in. in steel. They'll read to 0.0001 in. in steel; can measure a 5-mil wall in a ½-in. diam tube. Accuracy is about 1 pct. They have the advantage of being non-contacting and can also measure coatings by the backscatter principle.

Through relays they control strip thickness on mills, cable coating in extrusion, etc. There are more than 75 companies in the U. S. making these and other radiation measuring instruments with an annual volume of over $20 million.

X-rays have been used for inspecting welds and castings since 1920; radium came into the picture some 10 years later. Radioisotopes from reactors became available to industry on a limited scale in 1946. Cobalt-60 is the isotope principally favored in metalworking (i.e. to inspect castings and welds). It will also show internal defects in forgings and can take a "photo" of an entire assembly to show defective or improperly positioned parts. Cobalt-60 has the energy equivalent of a 2-million volt x-ray machine. It takes minutes to do what a large x-ray unit can do in seconds. But its cost is low (a fraction that of radium) and sources can be small (i.e. inside small castings).

While radioisotopes have a wide immediate use and interest, the possibilities of atomic

power have occupied the attention of over 70 important U. S. companies. In the group investigating it are utilities with more than 55 pct of U. S. generating capacity, plus top manufacturing and engineering firms.

Turning atomic energy into usable power can be divided into two categories: (1) The search for a nuclear power plant competitive with conventional fuels; and (2) military applications of nuclear power. On the commercial power side, the AEC is now pushing development of five reactors:

1. A pressurized water reactor (PWR) now under construction at Shippingport, Pa.—the first U. S. central station atomic power plant. It is being built by Westinghouse, will be operated by Duquesne Light Co., produce 60,000 kw of electrical power and should be completed in 1957. Ordinary water is pumped through this type reactor. Thus heated, the water goes through heat exchangers to convert other water to steam to drive a turbo generator.

2. An experimental boiling water reactor slated for completion at Argonne National Laboratory next year. Here, water boils in the reactor itself. Its steam is fed directly to the turbine, eliminating a heat exchanger. It will generate 5000 kw of electricity for the Laboratory. As in the PWR, ordinary water is moderator and coolant.

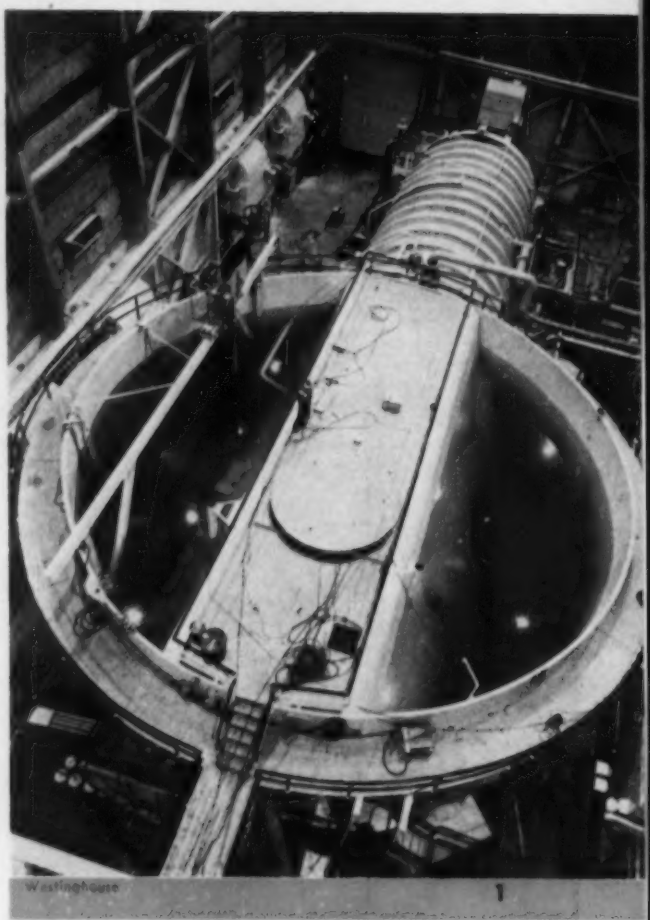
3. A sodium graphite reactor, now being built by North American Aviation, will be put into an underground tank filled with liquid sodium into which columns of zirconium-canned blocks will be placed to act as a moderator.

4. Homogeneous reactors in which the fuel is dissolved in a liquid moderator with the entire solution circulated as the coolant. A homogeneous thorium reactor scheduled for 1959 will have a heat output of 65,000 kw (16,000 kw of electricity). Thorium, more plentiful than uranium, makes this reactor interesting because it can breed more fuel than it consumes.

5. Development of other breeder reactors, producing more fuel than they consume, is an important AEC objective. One of these in operation in Idaho since 1951, has produced over 3 million kw-hr of heat on its first enriched uranium core. A larger breeder reactor (62,500 kw of heat to generate 15,000 kw of electricity) is scheduled to start operation in 1958.

Because of the uncertainties, industry has approached the power problem with caution. Despite this, Consolidated Edison (N. Y.) announced last February that it would build the first commercial power plant entirely financed by private capital. (The $85 million plant at Shippingport will be partly underwritten by the government.)

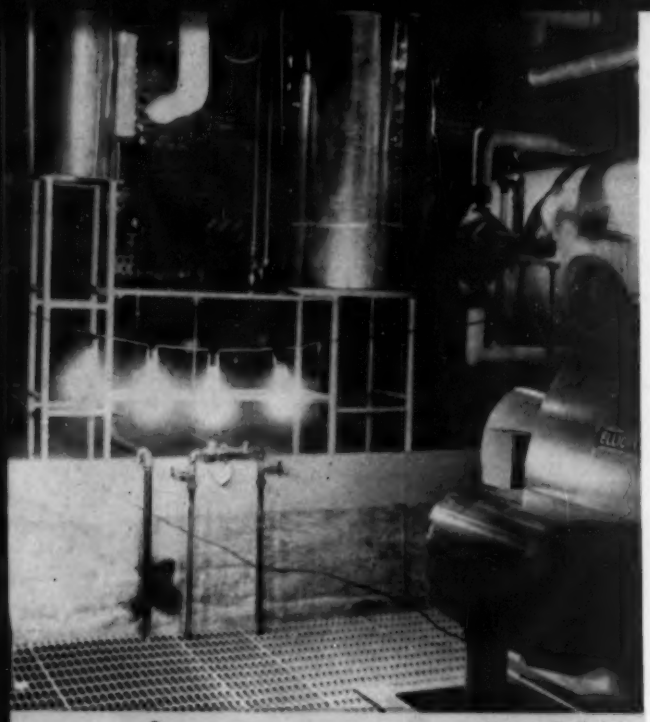
Cost of nuclear power is uncertain. The reactor in the *Nautilus* probably cost between $1500 and $2000 per kw. The Shippingport plant, less some development expense, will probably cost about $700 per kw.


Westinghouse 1

The Consolidated Edison reactor, to be built by Babcock & Wilcox, will have an estimated power cost of 9 mils per kwh.

The British Government, in announcing plans for 12 nuclear energy plants to be built within the next 10 years, estimated power cost at 7 to 8 mils, close to the U. S. coal power average. Total electrical capacity of the new British plants is scheduled at 1.4 to 2 million kw.

The *Nautilus*, which began sea trials Jan. 17, 1955, led the military power field, using a pressurized water reactor built by Westinghouse. At West Milton, N. Y., General Electric has completed the land based prototype of a nuclear power unit to drive a second submarine, the *Sea Wolf*. If work stays on schedule, this reactor



2 Argonne Nat'l. Lab.

will offer 10,000 kw of power for sale later this summer or fall. This would be the first commercial use of atomic power.

Westinghouse is also developing a PWR for large naval vessels, probably carriers. Newport News and Bethlehem Ship are making design studies on it. General Electric, Carbide & Carbon, Curtiss-Wright, and Pratt & Whitney Aircraft are doing research and development work on aircraft power plants; Baldwin-Lima-Hamilton on one for a locomotive.

American Locomotive has a $2 million contract to develop a 2000-kw "package" power plant for the Army, one which can be shipped to remote bases. This is the first reactor contract ever made on a fixed price basis, though Alcoa will probably lose money on it to gain experience.

New field for industry

Development of pumps and other equipment to transfer coolants, of valves and remote handling equipment has opened up a new field for industry. Much of this equipment was developed originally by contractors operating AEC installations but more of this work is now going to private companies.

The atomic energy industry uses more columbium-stabilized type 347 stainless, extra low carbon stainless, hafnium and zirconium than any other industry. Beryllium and titanium are widely used, too. A major problem is corrosion from radiation. Others include liquid metal coolants, development of structural metals with low neutron absorption, etc.

Metallurgists are also studying physical effects of radiation — such as change of shape, thermal conductivity, ductility, embrittlement, and corrosion.

1 LAND BASED prototype of atomic engine which drives Nautilus, under test in Idaho.

2 FIRST USE of electric power from atomic energy (1951) at AEC Idaho reactor test station.

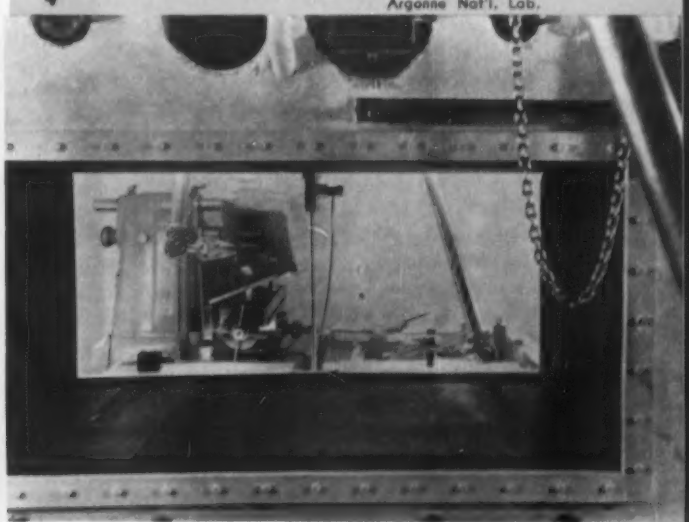
3 ISOTOPES just removed from pile are put into lead shipping container at Oak Ridge, Tenn.

4 MILLING radioactive material in a "cave." Photo was made through 3 ft of laminated glass.

3 AEC



4 Argonne Nat'l. Lab.



ATOMIC ENERGY

the future

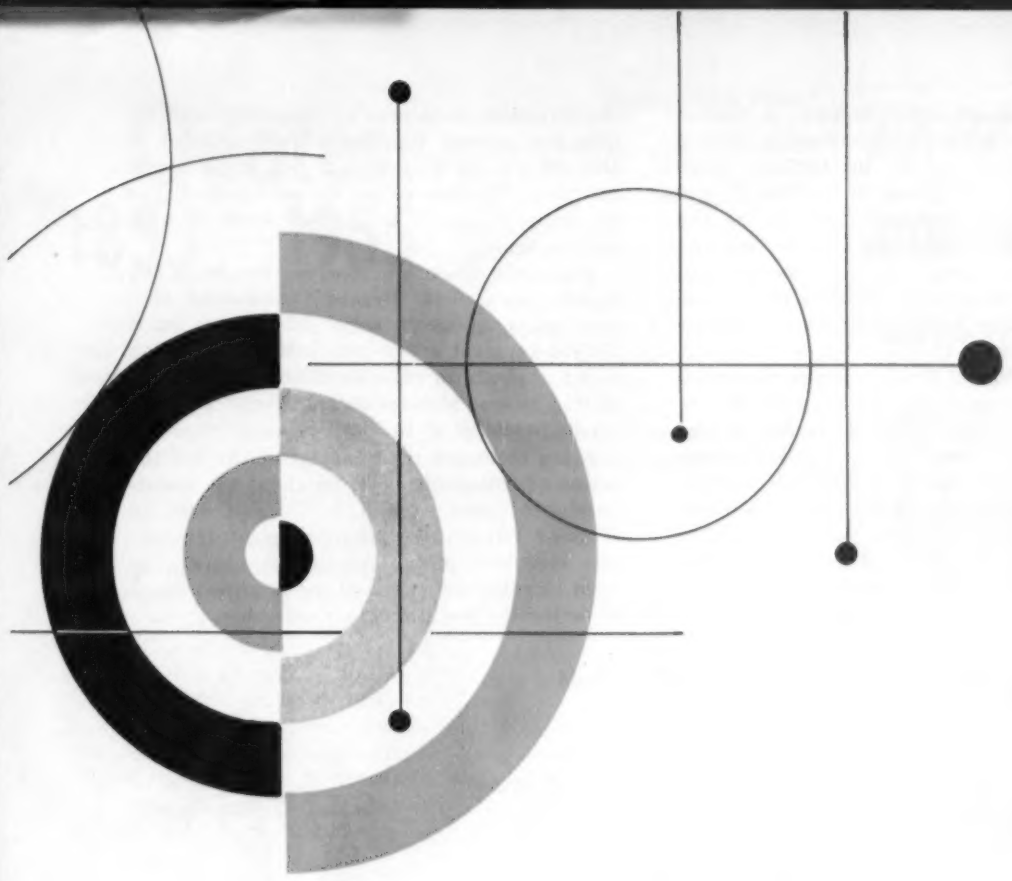
THE POTENTIAL POWER in atomic energy is staggering. Properly used it can raise living standards throughout the world to undreamed of heights. Meanwhile it is to be hoped that knowledge of the obvious consequences of atomic war will stave it off until "atoms for peace" can catch hold.

Only a few years ago commercial power was believed to be many years away. But last year R. J. Cordiner, president of General Electric said, "If private industry is given an opportunity to proceed with the development of atomic power, it is our optimistic estimate that, by 1975, 50 pct of the new electric power facilities then being installed will be atomic."

Speaking as an "individual," AEC Commissioner L. L. Strauss can see the time "within the lifetime of our grandchildren, perhaps sooner" when nuclear fuels may become cheaper than coal and oil, so that distribution of much more electricity to homes may be expected—so much that it will be unmetered—to use "for heating and cooling and everything else."

If all the energy in a pound of uranium can be recovered, as in a breeder reactor, it will be equivalent to 1300 tons of coal or 6000 bbl of fuel oil. While no one sees nuclear power displacing oil or coal in the immediate future—all three will continue to grow—the possibilities of exporting package power plants and of building larger ones in remote and undeveloped areas of the world are well beyond the dream stage.

For the immediate future, steps must be taken to permit U. S. industry to get into the nuclear field in a businesslike way. Either that or other nations with other ideologies, may do it first. Industry itself is taking what steps it can through associations like Atomic Industrial Forum, an association of industrial firms, educational institutions, labor



unions, research laboratories and other organizations dedicated to the development and use of atomic energy for peaceful purposes.

Some of the projects reported to this and other groups would have been in the science fiction class a decade ago. Through nuclear energy, the economic feasibility of converting sea water into drinking water may be only a few years away. The possibilities here are of course fantastic. In plastics, irradiation has produced molecular changes which may bring about a whole new field of materials.

Markets are growing

Prospects in agriculture and medicine may not seem directly to concern heavy industry but they definitely do. Ability to prolong life and halt certain diseases means population growth. Radiation will be widely used to preserve food, will affect its shelf life, marketing and storage. And since it has already created animal food the possibility of making food for humans can't be overlooked. Progress along these lines will naturally widen domestic and world markets for the products of industry.

There are other less spectacular ways in which industry will be affected by nuclear progress. To date, exposure of metals to nuclear bombardment has had negative results. But it is not inconceivable that additional research could produce the opposite effect, yield whole new families of lighter, stronger and more ductile metals.

Control of melting processes may be faster, more accurate, through wider use of radioisotopes. For example, if radioactive phosphorus were added to an open hearth steel heat the heat could be tapped when phosphorus, measured with a counter, got down to the desired level. This sort of work would depend on convenient local irradiation sources to produce (for safety) isotopes with short half lives. Such sources will come fast. American Machine & Foundry is planning one in New York for irradiation and experimental work.

Ionization sources have been built into fire and smoke detection equipment; dust precipitators are another potential growth application. Radioactive batteries now exist and several show promise for communications and instrumentation. For remote inspection radioisotopes like cobalt-60 may be rigged with a fluoroscopic screen and a television camera.

At the rate present applications are increasing and new ones being discovered, the radio-

isotope field alone could become a billion dollar industry within the forseeable future.

Use of atomic power in surface ships appears certain. The task of putting it into an airplane, once deferred because of the shielding weight problem, has been revived and is being pushed vigorously. If reactors can be made small enough to minimize the shielding problem other applications naturally suggest themselves.

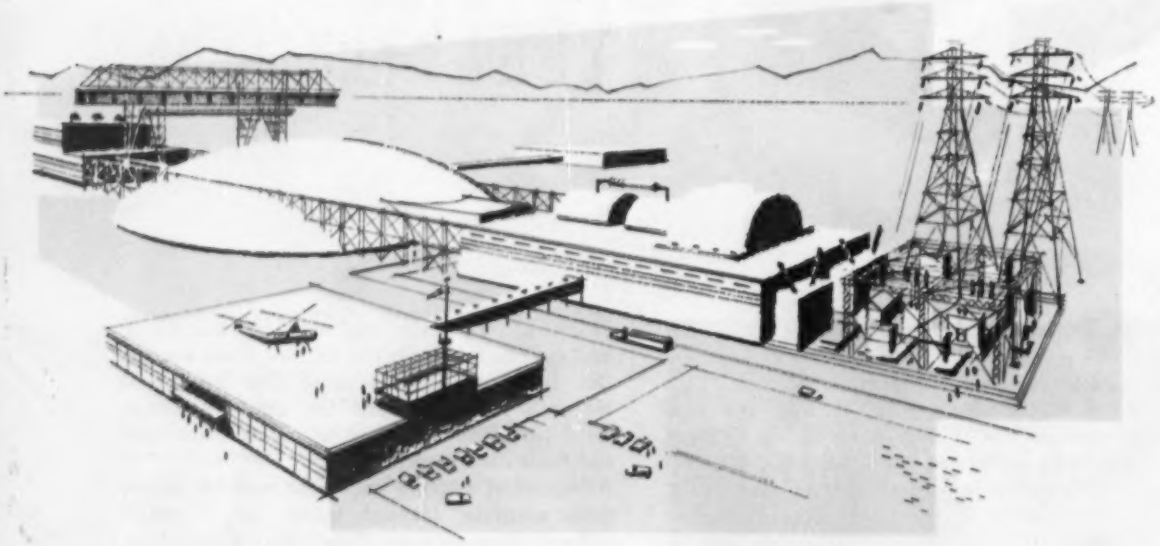
Another possibility is relocation of aluminum reduction plants, many of which now require that bauxite be hauled great distances to low-cost hydroelectric power sources. No one has yet suggested that nuclear power will soon be competitive with hydroelectric power but the hope is that it might some day approach it. Freight costs, plant, mill and market locations would then affect the industry. The same might be said for electric steelmaking furnaces and other processes that lean heavily on low cost power.

The groundwork for private nuclear power was laid by the Atomic Energy Act of 1954. Until then industry's relation to the government in this field was like that of employee-employer. By law the government awarded contracts only under very restricted terms, patents were rigidly controlled and dissemination of information severely restricted.

The 1954 act was written to encourage industry to enter into full partnership with the government. It was permitted to lease nuclear materials and to own licensed facilities to use or produce such materials. There were some improvements in access to classified information and private companies were allowed to seek patents on work arising out of their own research. Whether or not the act accomplished all these things is debatable; some changes may be made.

Meanwhile there are concrete results in the private power field. Beyond Consolidated Edison's plans to spend some $55 million on a 250,000-kw plant are proposals for $150 million worth of plants to generate 455,000 kw. They'd be in Chicago, Massachusetts, Detroit and Nebraska, would be 80 to 90 pct privately financed.

Sharp increases in living standards are the enemy of communism. Throughout the underdeveloped areas of the world, and even in Western Europe, the possibilities of inexpensive electrical power through atomic energy must be reckoned as one of the brightest hopes of saving the world from Armageddon.



ATOMIC POWER PLANT of the near future. Boilers and coal handling equipment are replaced by reactor (under dome-shaped concrete roof) and nuclear materials handling building. Sketch is based on design to be used at the Shippingport, Pa., plant which will be the first commercial central station power plant in the United States.

Here, water under pressure will be pumped through the reactor, thence to four heat exchangers which will convert other water into steam to drive the turbogenerator.

It has been estimated that within 20 years about half of all new U. S. power plants will use nuclear power.

Quotes: 1855 — 1955

Abstracts from past issues of THE IRON AGE, *selected for their flavor, and with some regard for whimsy:*

Uranium in 1914

The 1914 output of radium and uranium in the United States was the largest recorded according to the U. S. Geological Society. The production was about 4300 tons of ore carrying 87 tons of uranium oxide and 22.4 grams of metallic radium. Exports to Europe were a little over 1200 tons of ore containing 28.1 tons of uranium oxide and 7.2 grams of radium, but some of it was held in transit owing to the war.

Apr. 1, 1915

Uranium In Tool Steel

The latest development in the tool steel industry appears to be the application of uranium as an alloy in varying quantities.

Apr. 20, 1916

Income Tax In 1871

A correspondent called attention in our columns a few days ago to certain changes in the internal revenue law, which the assessors have apparently overlooked in preparing blanks for the income tax this year. The sources of income which are to be included are indeed defined by the law, but no one is compelled to disclose them to the assessor. It is only enacted that every person liable to the tax shall make and render a return of the gross amount of his income, gains and profits as aforesaid. An exemption is allowed for anyone whose income did not exceed $2000 during the year.

Mar. 30, 1871

Vulcanized Fiber

Among the many new materials designed to replace india rubber and leather for mechanical purposes, vulcanized fiber, to which we had occasion to refer a short time ago, seems to be deserving of careful consideration. Although, comparatively speaking, it is only a new substance, there are two cogent reasons which account for its great and increasing popularity, and these are its almost universal applicability to all mechanical requirements and its cost.

Apr. 9, 1885

Halsey Steam Truck

A new type of motor driven wagon, or truck, for heavy hauling, designed and manufactured by James T. Halsey, 1501 South Front Street, Philadelphia, is illustrated. This truck, which has a carrying capacity of 8 tons, uses steam as a motive power, with coal as fuel.

The fire box and the grate area are large enough to accommodate sufficient coal, pea grade, in one charge, working under slow combustion, for one-half day's run, equal to 30 miles, without the necessity of stoking during the entire run.

Normal speed is 1000 revolutions per minute, with a piston speed of 500 feet per minute, which corresponds to a speed of 10 miles per hour for the truck.

The body of the truck is very flexible, yielding readily to any irregularity in the roadbed. The water tank is suspended from the body of the truck and, carrying 1500 pounds, is of sufficient capacity for a 15 or 20 mile run, depending, of course, upon the condition of the streets or roads.

Sept. 14, 1905

ACKNOWLEDGMENT

The editors want particularly to thank E. A. Wiggin, Atomic Industrial Forum, New York, for assistance in reading the manuscript of this section.

EXPANSION BY MODERNIZATION WITH INDUSTRIAL



. . . CONTINUOUS BENCHING FOR ASSEMBLY . . . INSPECTION . . .



Today, in this world of atomic energy, automation and research, you must expand. BUT, expand the INDUSTRIAL way. By modernizing your present facilities to allow for this expansion.

STEEL TOP BENCHES
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WELDING BENCHES
STEEL TOTE BOXES

The complete installation of the new modern INDUSTRIAL (IB) line can be your method of expansion and at a minimum cash outlay. INDUSTRIAL, the quality line.

Check your dealer or write direct. Several dealer territories still open.

MODERNIZE FOR EXPANSION WITH

INDUSTRIAL



"Hot" atoms make better steels at Republic

The thickness of sheet steel is now being controlled at Republic by the use of a radioactive isotope.

The isotope, in amount equivalent to a few grains of salt, is in a device below the sheet steel. As the steel passes between rollers and over the "hot" atom, the thickness of the steel is registered on a device above the sheet.

This isotope implement permits Republic to control sheet thickness far more accurately than ever before.

Republic is developing more extensive use of isotopes as tracers.

Other applications of isotopes are now in development stages which will permit Republic to detect important conditions inside steelmaking equipment. Until now these conditions have been beyond precise control because there has been no convenient way of seeing through walls of metal or brick. The radioactive isotopes, being able to penetrate such walls with their rays, will provide a means of "seeing" some of the things which go on inside a furnace.

REPUBLIC STEEL

World's Widest Range of Standard Steels and Steel Products

THE ATOM SUB

is so much more than a weapon

If you look into the atomic submarine with the eyes of the future, you will see a means of creating leisure that may exceed the blessing of any other invention of all time.

Inside the sub is an atomically fueled boiler. It is the proving ground for other atomic power plants. It could be serving a housing development or a hospital. That power, which enables the submarine to "stay down indefinitely", should ultimately heat the boilers of a building cheaply.

Both in England and at Hanford, Washington, buildings are now being heated with atomic energy.

How soon the heart of the atom sub becomes the heart of a more pleasurable and peaceful world depends largely upon the will and ingenuity of man.

But peaceful use of atomic energy is only about nine years old. Encouraging civilian progress has already been made. Within the next nine years, how much more can come?

Republic Steel is especially aware of atomic power: first, because we are *large consumers* of *energy;* and second, because we have furnished so much of the stainless steel needed for atomic applications. Stainless is used for sewage disposal systems carrying atomic waste; for handling and containing equipment; for the counters, floors and walls of "hot" labs. As the demand for atomic energy expands from year to year, the demand for stainless steel follows. When you use "hot" materials, remember that Republic is staffed with experts who can assist you on many aspects of atomic applications. They are ready to serve you.

Republic Steel—as a supplier of special steels for many atomic installations, as an applier of radioactive isotopes to its own business and as a huge consumer of power which may very well be power from atomic energy some day—is deeply interested in atomic applications involving the use of steel.

When you are putting steel and atomic energy together on your drawing board, write Republic for consultation. Address your correspondence to Republic Steel, Cleveland 1, Ohio.



REPUBLIC STEEL, largest manufacturer of stainless and alloy steels, makes stainless steel for atomic ash cans and other parts of storage and disposal systems.

New Galvanic Battery, Electric Clock

The Telegraph Supply Company, at Cleveland, have lately introduced a new galvanic battery and new electric clock; also a new dinamo electric machine for electro-plating. Beside these they have a new electric light machine for lighting large manufactories, depots, &c. They have just shipped a complete electrical instrument to the Jackson mines at Negaunee, Mich., for telegraphing from each of the mines to the hoisting engines.

Nov. 9, 1876

Business Failures Low

The business failures occurring throughout the country last week, as reported to R. G. Dun & Co.'s Mercantile Agency, are the fewest chronicled in any one week since the year 1885 commenced. In the United States there were 197 and in Canada 34, a total of 231, as against a total of 277 last week and 258 the week previous to the last. Three-fourths of the failures were in the Western, Southern and Pacific States.

Apr. 9, 1885

Would Import Labor

The Mexican Navigation Company ask authority from the Government to import 20,000 Chinese coolie laborers.

Apr. 9, 1885

Wall Street Feverish

The past week has been one of considerable excitement in Wall street. The feeling has been feverish and depressed, and there has been considerable speculative activity among the "bears" who, emboldened by the success of their attack upon the stocks and bonds of the Central R.R. of N. J., have gone at the entire list and done all in their power to break it down. Thus far their success has not equaled their anticipations, but they have not yet given up the attempt, and with a little encouragement on the part of credulous investors who may be frightened into selling, it is not improbable that they will succeed better than the condition of the enterprises raided against may really warrant. The money market continues easy, with rates on call loans 1 @ 2 per cent. Prime mercantile paper is quoted at 3 @ 4 per cent.

Sept. 7, 1876

The Panama Canal

Mr. Robertson, of Louisiana, has discovered the true aim of M. de Lesseps and his fellow-schemers, and has invoked the aid of Congress against their infamous designs by introducing the following resolution:

Whereas, The warm stream of the Atlantic before entering the Gulf of Mexico strikes against the eastern coast of the Isthmus of Panama and would continue to the Pacific but for the existence of that narrow barrier; and

Whereas, After leaving the Gulf it flows across the Atlantic past the coast of Great Britain, creating the temperate climate of that country, which otherwise would have the cold climate of Labrador; and

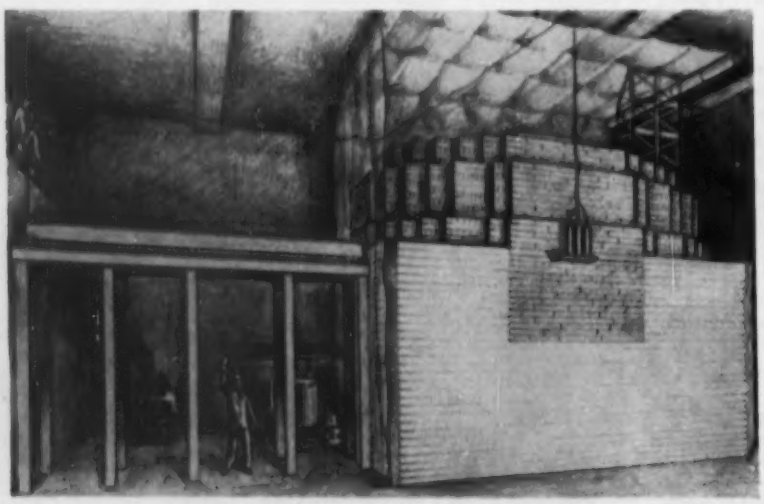
Whereas, It is an admitted scientific fact that a tide-level canal of sufficient width across Panama would change the course of the Gulf Stream, and thereby freeze out an English-speaking nation; and

Whereas, The United States would thereby lose its chief foreign market, which loss would not be counterbalanced by the new markets opened by an interoceanic canal; therefore

Resolved, That we emphatically reaffirm the Monroe Doctrine, and that we will bring it to bear against the inhuman designs of France in thus attempting to destroy her chief European rival, and injure the commerce of the United States.

We now expect to see all Englishmen converted to the Doctrine.

Apr. 1, 1880

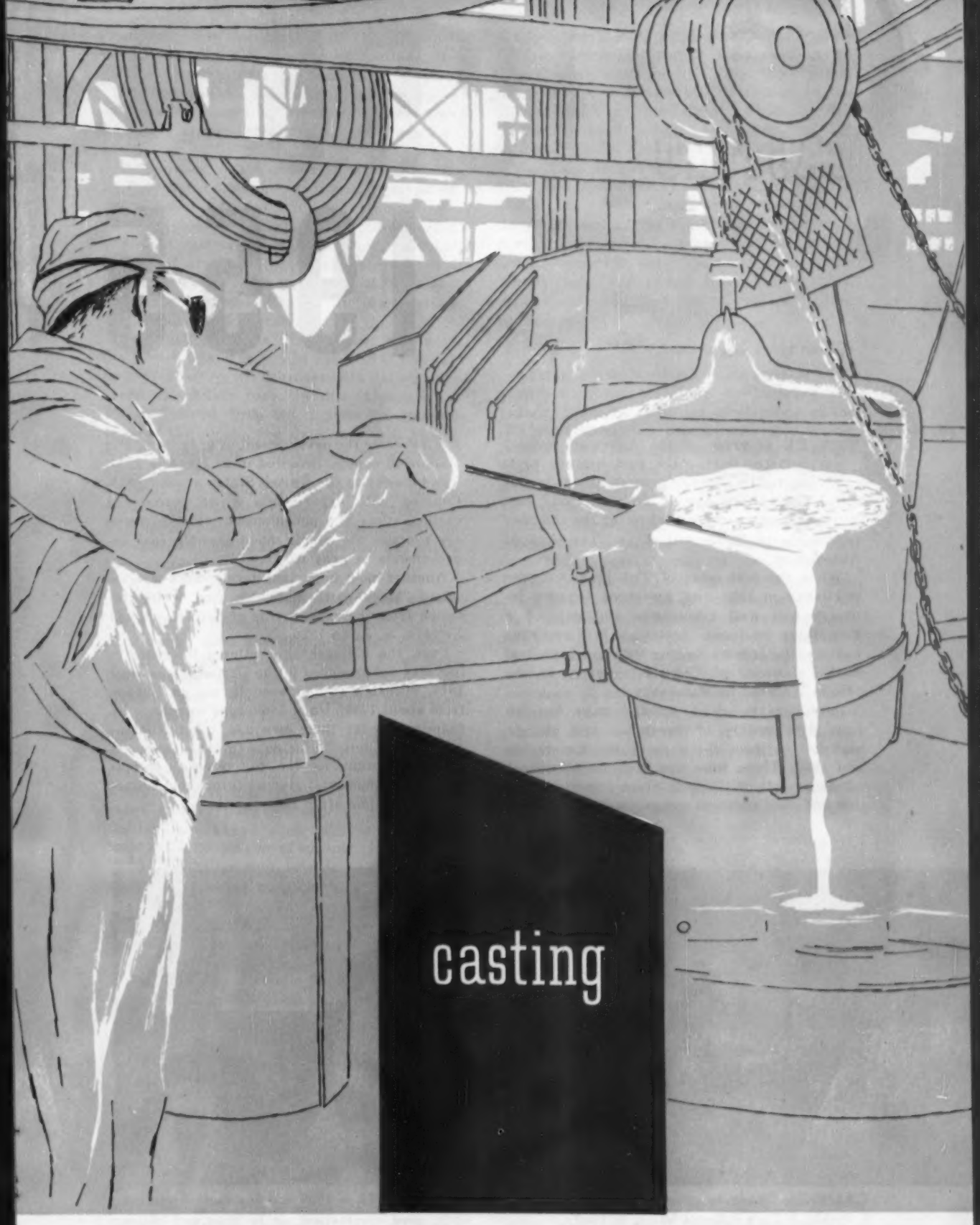


FIRST SELF SUSTAINING nuclear chain reactor. Sketch shows world's first atomic pile which went critical on Dec. 2, 1942, at Chicago.

Tubes Successful

The pneumatic tubes at the Western Union main office in New York are a practical success. About 1000 messages are received through them from 14 Broad street, daily, and about 750 sent. The expense of laying these tubes was about $8000, but the cost of working is much less than if wires were used, while business can be handled much quicker and without possibility of mistakes.

Nov. 9, 1876



100 YEARS OF METALWORKING

In 1828, the introduction of the hot-blast

the Halcomb Steel Co., Syracuse, N. Y., in 1906.

CASTING 1855 1955

THE progress of the American foundry industry during the past century could be fairly accurately summed up in one phase, "The Age of Mechanization," just as the present and near future of the industry is coming to be described as "The Age of Automation."

When the first issue of THE IRON AGE was published in 1855, the American foundry industry was well established and enjoyed a flourishing business. America's first recorded casting, the famous Saugus Pot, had been cast in the dawning of Colonial industry at the "Irone Workes" in Massachusetts.

Developments which set the stage for the Iron Age century of expansion and change occurred between the days of the Revolution and 1850. There were five basic metallurgical advances—all of them of great importance to iron and steel smelting and processing.

First came the development of gray iron. The Wilkinson cupola, invented in England in 1794, was brought to the United States around 1815. Coupled with experiments which introduced carbon, silica and phosphorous into the smelting process, the cupola made possible vast improvements in gray iron quality.

Another most important development was so-called "blackheart" malleable iron which resulted from the experiments of Seth Boyden in Newark, N. J., in 1826.

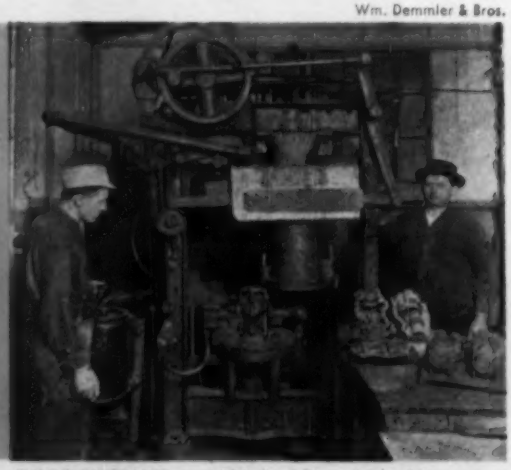
Coke, the indispensable adjunct to ironmaking, was not produced in the United States until 1817, although it had been in use in Europe from about 1750. Until 1860, coke was made by foundrymen for their own use, but the introduction of Connellsville coke in 1841, produced in beehive ovens, led the way to coke's acceptance as a commercial product throughout industry a short time after 1860.

Allis-Chalmers Mfg. Co.



CASTINGS "made to order" were produced at E. P. Allis & Co.'s Reliance Works in 1860's.

Wm. Demmler & Bros.



CORE BLOWER in 1909 had line shaft driven carriage, used compressed air to blow and clamp.

In 1828, the introduction of the hot-blast furnace by James B. Neilson of Scotland, increased output of furnaces from 10 to 40 pct.

The first crucible steel was produced in 1831-32 when William Garrard of Cincinnati discovered a proper refractory clay in West Virginia.

Development of the converter about the turn of the century was of course a tremendous metallurgical advance (see Iron and Steel).

Thus basic ingredients for successful iron and steel castings were known and available in most of America's industrial centers by 1855 but the actual process of melting, molding and pouring of castings, was for the most part, a small scale, hand operation.

Introduction of the drop bottom cupola in the New England region in about 1850 was the first of a series of improvements designed to speed up melting time. In this furnace blast was introduced from two tuyeres on opposite sides of the cupola, the stack was built higher and narrower and a melt could be poured in about 10 hours.

About 10 years after the first drop bottom cupola, the one-piece cupola was introduced. This model had a boiler plate casing with an air chamber and blast tubes around the entire circumference of its base.

Develop commercial cupola

Parallel to these rapid developments in furnace design came the design of high powered blowers driven by steam engines. These were the "cyclone" type made by B. F. Sturtevant and the "box" type Rootes blower introduced commercially about 1855-60.

Availability of such blowers providing high-powered blast led to the development of the first commercial cupola in the U. S., the Colliau, which was a fast, economical unit of prefabricated construction. Introduced in 1874, the Colliau cupola had such innovations as hot blast and a double row of tuyeres.

The Whiting cupola, introduced in 1885, had adjustable tuyeres which enabled founders to use different fuels and change blast for different classes of work.

Casting of steel was developing rapidly during the second half of the 19th century. Bessemer's improved converter was first installed at Troy, N. Y., in 1865. Concurrent with the introduction of the converter came the Siemens-Martin openhearth which was first experimented with in 1845. However, it wasn't until 1857 that the invention of the gas producer made possible the higher heat available using the regenerative principle. The first openhearth steel in America was poured in 1870.

The electric arc furnace, although invented by Sir William Siemens in 1878, did not get much use until later improvements were made. The first electric furnace in the U. S. was at the Halcomb Steel Co., Syracuse, N. Y., in 1906.

First commercial use of steel castings on a large scale came in 1867 from the William Butcher Steel Works (which later became the Midvale Co.) in Philadelphia. First foundry to produce steel castings exclusively was the Pittsburgh Steel Castings Co., started in 1871.

Handling of molten metal began to benefit from the foundryman's attention during the 1850's and '60's. Cranes were developed to transport ladles from the cupola to the mold floor. Pouring from ladles, however, was a hazardous operation until the invention of the "safety ladle" by James Nasmythe in 1867, which was controlled by a geared tilting mechanism.

Seek faster mold output

Making of molds for casting was a hand operation which had long bottlenecked the foundry industry. With the development of the efficient fast-melting cupolas described above, came a tremendous impetus to find a means of speeding up the production of molds. In 1837, a jarring type machine was made by the S. Jarvis Adams Co. which, although it was of crude design, was practical. There were many unsuccessful approaches to the problem. Not until 1890, however, when Charles Herman of Pittsburgh, founder of Herman Pneumatic Machine Co., devised and patented a power-operated machine to compress the molding sand (which was poured into the cope and drag flasks from a chute) around the pattern by jarring the frame which held the mold. This was done by means of belt-driven cams.

Later in the 1890's, introduction of compressed air power into foundries made it possible to substitute air power cylinders for the belt-driven cams.

Permanent, metallic molds as opposed to those pressed from sand and loam were limited

Bettman Archive



CORE MAKING in the late 1880's. Cores were dried in kilns and sorted in racks at the side.

by the metals available. Perhaps the greatest development of permanent molding came with the centrifugal casting process (the pouring of molten metal into a rapidly revolving metallic mold), which was pioneered in England by A. G. Eckhardt as early as 1809. Centrifugal casting was used by American pipe foundries in Baltimore beginning in 1848.

Centrifugal casting of steel was first accomplished by the American Steel Foundries in St. Louis, Mo., around 1898. Car wheels were first spun-cast in Rockford, Ill., in 1901. Concurrent to the development of the centrifugal casting process came the device, patented by B. H. Dusenburg in 1877, for machine-casting of Babbitt metal bearing parts. Hand pressure on a lever forced the alloy, heated to approximately 650°F, into the metal mold or die.

Two additional permanent-mold casting methods were evolved during the latter 19th century. One, slush casting, is a process where liquid metal is poured into a metallic mold and as soon as the skin has set, the still-liquid center of the casting is poured out. The other method, Cothias casting, which can only be applied to certain shapes of objects, involves a metallic mold and permanent core which is forced into the liquid metal.

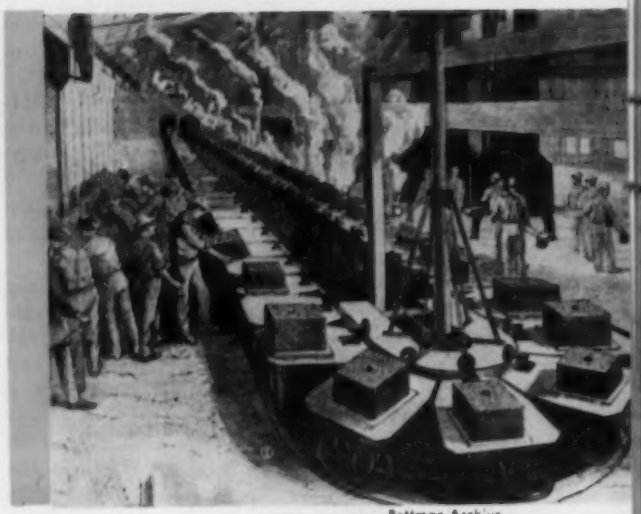
Just as the development of faster and more efficient melting furnaces spurred the development of mold-making machines, so in turn, founders were forced to improve the quality of the molding sand. The first devices, developed in the 1870's, were paddle-type mixers to combine the clay, brick, coal and coke with the sand. A later development was the centrifugal ball mill which rotated iron balls in a circular trough to further mix and pulverize the molding materials.

Mechanize sand handling

At the close of the 19th century founders began to use the edge runner with its revolving pan and metal paddles which acted on the sand mixture somewhat like a druggist's mortar and pestle. In 1912, a much-improved mulling device was marketed by Peter L. Simpson. This device has individually-mounted, revolving mullers.

Coremaking, basically a hand operation until after the turn of the century, was much aided by the development of specialized core ovens such as the one made by Eli Millett in 1887 which had individual drawers for drying smaller size cores.

Physical handling of mold sand took on greater importance as the other foundry operations became mechanized. Overhead bins, chutes, and mechanical conveyors were being installed in foundries during the 1880's. Development of continuous rubber conveyor belts as well as improved metal bucket conveyors, in the first decade of this century, just about ended the shovel-and-wheelbarrow method of



Bettman Archive

CONVEYOR BELT in 1890 foundry had series of tables carried on wheels and linked together.

sand handling in U. S. foundries. Sand preparation and conditioning was further implemented by the power-driven riddle, introduced in 1912.

Development of the sand slinger in 1926 provided a mechanical means of introducing sand into large mold flasks without need for running the flask under a fixed sand chute. Additional improved flask filling devices were devised by the Jeffrey Mfg. Co., of Columbus, Ohio, during the 1920's.

Mold conveyors, brought into U. S. foundries in the 1890's, provided the first assembly line operation in the industry. These consisted of a continuous line of small cars on an oval track which ran on the foundry floor. The cars moved at a slow pace from the mold machine, close by the cupolas for pouring, then through a long run for cooling and finally to the shakeout station. Except for vast improvements in the speed and accuracy of the individual operations the system remains basically the same today.

Sand shakeout was for the most part a manual operation until the development of specialized shakeout machines, essentially fast-vibrating gratings which loosened the sand from around the casting and out of the flasks. Simplicity Engineering Co., and the Allis-Chalmers Co. led in developing of various types of shakeout machines in the 1920's and 30's.

Early cleaning and finishing of castings was done by hand. Tumbling mills, first developed by W. W. Sly of Cleveland in 1880-87, were a tremendous improvement and did much to reduce or eliminate the hand-chipping and grinding of smaller castings. R. E. Tilghman of Philadelphia developed the sandblast in 1870 for large castings. Not until the turn of the



Link-Belt Co.

CONTINUOUS mold conveyor installation in 1916. Mechanization was stimulated by World War I.



Beardsley & Piper Div.

WOODEN BUCKET elevator supplied sand to stationary slinger at southern plant in 1926.

century, and the wider use of cleaning compressed air equipment, did sand blast cleaning equipment become practicable. Mechanical conveyors which take a continuous line of castings through closed blast chambers have been developed during the last 30 or 40 years by the Pangborn Corporation of Hagerstown, Md., and American Wheelbrator & Equipment Co. of Mishawaka, Ind.

What is rapidly proving to be an extremely important new development in the American foundry industry, the shell molding process, has only been generally available in the country since 1950. Shell molding uses patterns which press a thin-sectioned mold out of carefully conditioned sand mixed with phenolic resin. After a short curing time the shell molds are released from the patterns and may be stored easily in a space no larger than that needed for the finished casting.

Diecasting machines advance

When castings are to be poured, the cope and drag shell molds are fastened together with spring clips and set in a box of back-up sand or metal shot. Sand usage is cut down to only 10 pct of the quantity needed for conventional mold casting.

Recently increased use of investment or "lost wax" casting for commercial production, has come about in the past 5 or 10 years as a result of the demand for special, high-precision work. This method, previously used only by dentists and those casting bronze statues, is almost as old as the history of casting itself.

Diecasting traces its early beginnings to the middle of the 19th Century, but modern diecasting—the forcing of molten metal into an accurately shaped die cavity—descends directly from the type-casting machinery of 1900.

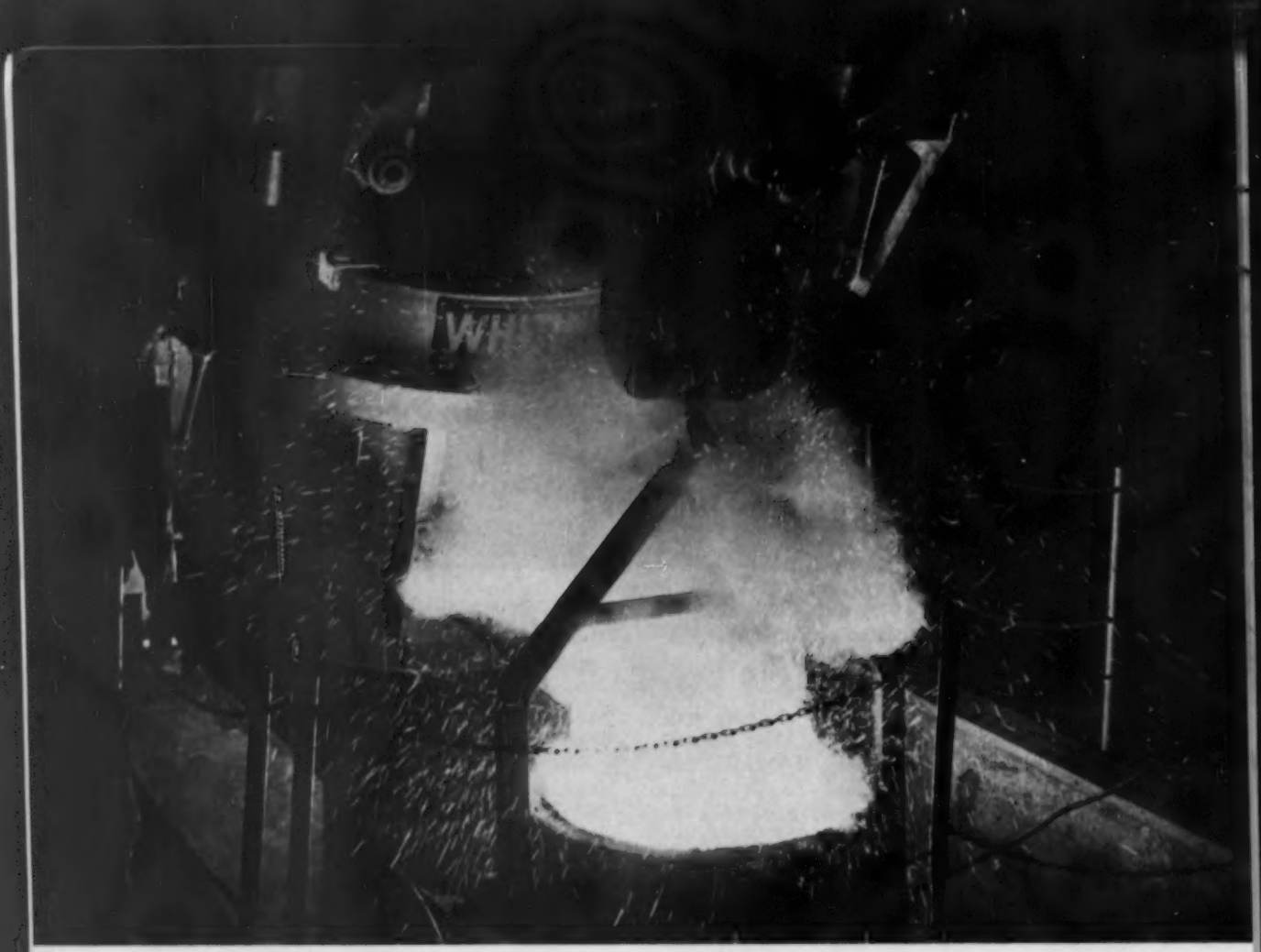
Low melting-point casting materials such as lead or tin and their alloys, were first used. But stronger metals were sought—the use of zinc and zinc alloys for diecasting became widespread by 1920. Continuing the search for stronger metals, experimentation with copper-base materials, primarily brass, started as early as World War I, with industrial acceptance coming in the 1920's. During the same period, with the "light metal" age on the horizon, intensive research on the use of aluminum and aluminum alloys as diecasting metals was carried on, with 1930 generally noted as the year of commercial acceptance.

While the range of diecasting metals and alloys progressed, diecasting equipment kept pace with growing industrial demand for high-speed production of larger and more intricate components. Early hand-operated machines were replaced by larger power machines capable today of producing large one-piece die castings at a high production rate.

During World War II, the requirement for light, strong metals brought aluminum and aluminum alloys to the fore and increased the acceptance of magnesium as diecasting metal.

No record of the past century's foundry developments would be complete without mention of the various foundry organizations which since their inception have contributed so much to the advancement of the foundry industry in this country.

These organizations have made a great contribution in bringing order, uniform product quality and specification accuracy to an industry which has undergone an amazing technical revolution in the century just passed.



HEAT OF STEEL for castings is shown being poured from 6000-lb capacity electric furnace.

Whiting Corp.

CASTING...

POURING molten metal at temperature into the cavity of a red hot investment flask.

Arwood Precision Casting Corp.



the present

Since 1945 just about every phase of foundry processing has advanced — molding, sand technology, foundry equipment, use of alloys, testing equipment, control and materials handling.

New and better grades of synthetic sand are now available. Better non-sand mold materials, including alloy irons, alloy steels, refractory and ceramic molds have been introduced. Improved materials have been found for separating castings from their molds, including the useful silicone preparations. Die castings have jumped in size from a few pounds to as much as 100 lb.

Baked sand molds and mold cores having higher strength and hardness have been made possible by improved core oils and resins. With better sands and improved binders and an automatic multiple-station molding machine, harder and more accurate molds are being made faster and more efficiently.

Magnesium is a coming metal in the foundry industry. Problems that originally limited the use of magnesium castings have found an economic solution. New high temperature alloys have been developed.

Greater use of induction furnaces and the introduction of vacuum melting are significant. Vacuum-melted metal, free of undesirable impurities, has properties substantially beyond those obtainable with conventional processes.

In the melting field, pressurized cupolas have attracted considerable attention by the foundry. An automotive foundry has produced large tonnages of iron in a cupola at pressures 3 to 5 lb above atmospheric. The pressurized cupola has a closed top with a double bell for charging.

The prerequisite for automatic handling in the foundry—large or small—is standardization. Foundries are mainly concerned with handling containers — ladles, flasks, core boxes, driers and core setting fixtures. To the extent that these containers can be standardized, automatic handling, or at least semi-automatic handling methods, can often be used.

Along with advances in methods, the materials available to the foundryman have also progressed rapidly since World War II. This period has seen the introduction of ductile iron and its rapid acceptance in industry. Many parts have been converted to malleable iron as its properties have become more widely known and pearlitic malleable production has doubled during the past 10 years.

Meanwhile the 200-year-old gray iron foundry industry has made more progress in improving production methods and working conditions during the past 15 years than in any similar period. An interesting point which the steel casting industry is emphasizing is a new design approach using stress analysis as a design tool. The method not only develops maximum efficiency but improves appearance because the casting shape takes on the stress flow pattern.

Ductile iron has come a long way since its introduction to the U. S. metalworking industry just seven years ago. In a brief period, foundrymen have learned to avoid the earlier production problems associated with ductile iron and to produce a highly satisfactory new engineering material. Earlier foundry problems have all but disappeared. Ductile iron can now be produced regularly to rigid specifications, starting at 60,000 psi for un-heat treated iron up to as much as 175,000 psi for heat-treated grades.

Shell molding has emerged as the most promising method for precision casting introduced to the foundry industry for many years. Old limitations on the size of precision castings have been lifted. Castings ranging from a pound to several hundred pounds can be made. Tolerances of 0.004 in. or less are possible.

Shell process cuts handling

The Croning or "C" shell process eliminates more than 90 pct of sand handling. Perhaps its greatest advantages, in addition to the production of high quality products, is ability to lend itself to automatic handling. No process brought to the foundry in the past 50 years promises to do so much toward taking the dirty, back-breaking work out of the foundry and substituting in its place a comparatively clean, efficient high production process.

One of the virtues of shell molding is the fact that virtually any metal, ranging from nonferrous metals to high temperature alloys, can be cast. Sand inclusions on the surface are practically unheard of.

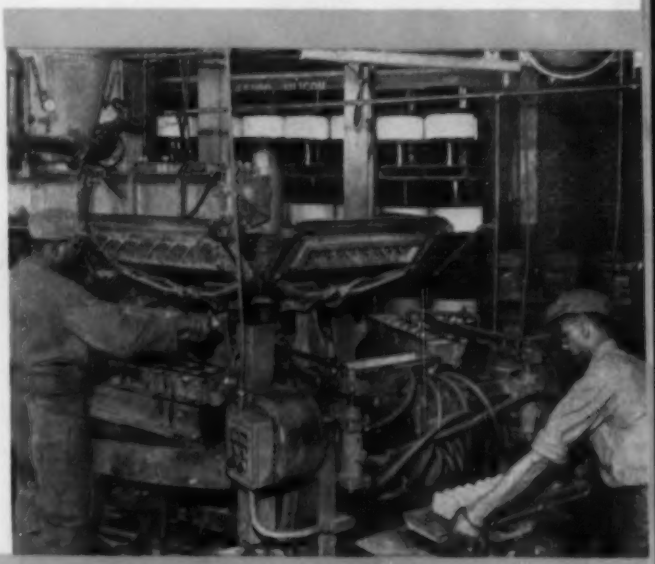
While shell molding originally promised large savings in machining costs—and still does—other processing advantages may turn out to be equally important. There is, for example, well-established evidence that it actually costs less to produce some castings by the shell mold method than it does to make the same casting by conventional sand methods.

Another advantage of shell molding is reduced scrap. One foundry has reported a reduction in scrap from 30 pct to 1 pct.

There is the further advantage in shell molding of having less loose dirt in the mold. This becomes significant, for example, in the production of cylinder heads for automobile engines.

Ability to produce a smooth, inside surface by the shell molding process is a distinct advantage in certain high production castings like cylinder heads and manifold. A smooth inside surface and freedom from fins permits unobstructed passage of water through cored openings in the casting. The cores are also being made by the shell process.

Shell cores, incidentally, are receiving very serious consideration from many foundry managers these days. Both the quality and intricacy of shell-made cores is outstanding. Cores that could not be made by any other process can be made by the shell method.



2 Osborn Mfg. Co.



1 Acheson Colloids Corp.

The production of gray iron castings in mechanically operated metal molds offers an excellent method of producing sound, accurate, readily machinable gray iron castings in large volume and at comparatively low unit cost. Tooling costs can be amortized quickly where runs are sufficiently long.

The uniformly high quality of the products has attracted a growing number of users in the automotive, refrigeration, washing machine, earth moving equipment and other industries. Representative parts include hydraulic brake cylinders, oil pump bodies, worm gears, com-



3 Top—Link-Belt Co. Bottom—U.S. Pipe & Foundry Co.

1 SOLIDIFIED permanent mold aluminum casting is lifted out of metal mold by tongs.
2 MECHANIZATION of foundry tasks is growing as shown by this automatic coremaking machine.
3 Top: CONTINUOUS power mold conveyor used in mold assembly, pouring, cooling and shakeout.
3 Bottom: DUAL METAL centrifugal castings combine metals having different properties.
4 MOLTEN metal is poured into shell molds. Shell molding has advanced rapidly in a short time.
5 SANDSLINGER distributes sand uniformly in mold. Unit is hydraulically controlled.
6 LARGE aluminum cable reel flange weighing 31 lb was die cast in a huge 72-in. machine.

pressor housings, valve bodies, valve guides, rotors, master brake cylinders and crankshafts.

Castings are made in air-cooled, permanent metal molds as they are carried through the casting cycle on a rotating machine at a constant speed. The permanent mold is given two separate coatings on its face. This prevents adherence to the mold and also reduces thermal shock. The base coating is a refractory clay. The second coating used is in the form of carbon smoke.

Build low-cost molds

Castings include both solid and cored types. A wide range of designs is being produced successfully.

Molds normally produce from 3000 to 10,000 pourings but some molds can be built economically to make as few as 500 pourings.

Machining is excellent, due to the absence of scale and uniform microstructure of the casting. Dimensional accuracy and uniformity is outstanding. A dense, porous-free structure is produced.

Permanent mold castings range from ½ lb to 12 lb. Size range is from 2 in. diam by ½ in. thickness to 10 in. diam by 1 in. thickness. Permanent mold iron is in the 30,000 to 40,000 psi range. Tensile strengths up to 70,000 psi are available following heat treatment. Surface condition is excellent.

Technological progress in the die casting field has been unusually rapid during the past 10 years. Faster cycles have been made possible. Better controls for time and temperature have become available. The entire process cycle can now be controlled more accurately. Automatic ladling has been introduced.

Typical applications of die cast components include parts for automotive torque converters of aluminum, chrome-plated zinc die castings

4 Cooper Alloy Corp. 5 Beardsley & Piper Div. 6 Doehler-Jarvis Div.







for auto grills and trim, basic housings and components of major home appliances such as sewing machines and washing machines, frames and parts of office equipment such as typewriters and calculating equipment, and picture frames of television sets as well as other trim components of both radio and television sets.

Extensive experimental work continues on the development of satisfactory die materials for die casting. Longer die life and better surface finish continues to be long-term objectives of researchers in the die casting industry.

The capacity of modern die casting machines has grown rapidly. Equipment development, keeping pace with growing industrial demands for larger precision parts, is highlighted with the recent announcement of the largest die-casting machine ever built, capable of handling dies over six feet in diameter. The machine has been developed for the purpose of producing such large items as auto engine cylinder blocks and inner door frames for passenger cars. Some die castings weigh up to 100 lb.

Closer tolerances and reduced flash have been made possible as the design of dies and locking equipment has improved. Great strides have been made toward promoting safety and trouble-free operation.

Die casting's ability to produce nonferrous components at a rapid rate with high precision, smooth surface finish, and consequent reduction or elimination of machining are making this process more competitive.



Investment cast intricate parts

Investment casting as a means of avoiding costly machining and assembly operations in small, intricate metal parts is presently receiving more attention from industry.

Investment casting methods are important in that they can handle any commercially significant metal or alloy which can be cast in currently available furnaces. Metallurgical control remains a continuing problem in improving metal structure and dimensional accuracy. Commercial tolerances for ferrous or high temperature alloy parts is about plus or minus 0.005 in. The mercury process permits plus or minus 0.003 in. for all alloys. Similar tolerances can be obtained for some parts in aluminum or copper base alloys cast from wax or plastic patterns.

Development of new high nickel high chromium alloys in which cobalt is less important has increased the suitability of precision casting as a means of producing turbine buckets. The parts cast have shown worthwhile performance records.

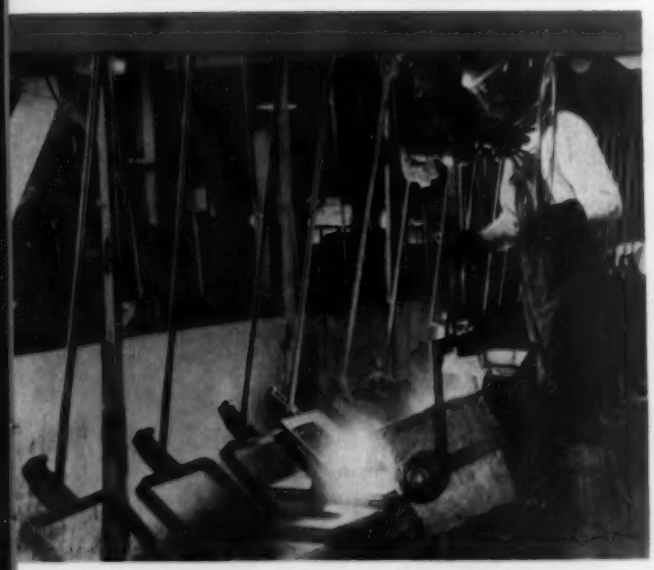
More than 50 pct of the production of "precision" castings is in pieces weighing one ounce or less. Considerable progress has been made however, in the manufacture of such parts as Wright turbo-boost diaphragm castings weighing over 17 lb with a 14 in. diam as cast. Ceramic



7 AIR MELTING and casting, left, is being replaced by vacuum methods for making jet blades.

8 EASY operation of ladle and handler make this pouring operation more efficient.

9 CONVEYOR line for pouring small castings is equipped with automatic weight-setting devices.



shell molds are particularly suited for designs which incorporate extensive areas of thin-walled metal in which surface regularity is important.

Research programs are now being conducted to find means of reducing the cost of the investment casting process. Efforts are being made to replace the solid investment blocks now being used with ceramic shell molds. This could be an important technological advance toward reducing costs and improving quality.

Ceramic shells are now only made by the frozen mercury pattern technique. Major stumbling block to universal use of the ceramic shell is prevented by chemical and thermal properties of wax or platens.

Several foundries using wax and plastic patterns have research projects underway to solve the problem of extracting these patterns from "unfired" green investment shells. Solution of the thermal problem involved would permit a major reduction in foundry costs and help improve casting quality.

Wider application of centrifugal casting methods was given considerable impetus during World War II for the production of various military components by both the true centrifugal and centrifuge processes.

Highly developed was Watertown Arsenal's method of centrifugal gun casting using a metallic mold. Huge quantities of aircraft cylinder barrels and cylindrical tank parts and various other short-length tubular steel products were made in horizontal metal molds.

Since 1945 significant technological advances have been made in the true centrifugal casting process employing metal molds in a horizontal position for the casting of hollow cylinders.

Control coatings better

Of fairly recent major importance is the development of a means for better controlling coatings applied to metal molds. The coating method combines the advantages of rapid solidification obtained with metal molds and the ease of casting found in those processes employing slow freezing.

Advantages of the process include smoother distribution of molten metal, casting of longer lenghts, and easier withdrawal of the casting. One of the most important outgrowths of the process is the development of a method for making hollow cylinders out of more than one metal. Dual metal centrifugal castings make possible the combining of metals each having unique properties which no single alloy can combine.

Centrifugal castings of both ferrous and nonferrous materials have several important benefits. Because no gates or risers are used, yield is high—about 90 pct or more. Uniformity of centrifugal castings compare with wrought material with the added advantage of their mechanical properties being nearly equal in all directions.

CASTING

the future

Future developments in the foundry field will certainly include improved metallurgical and size control. Better quality control, including reduced porosity and better surface finish can also be expected.

Improved melting techniques, utilizing complete or partial vacuums or controlled atmospheres at high pressures, will become increasingly popular. Diaphragm molding is promising a new pressure technique for making molds.

Other expectations for the future include: Growing use of synthetic instead of natural sand; More competition from investment castings coupled with an increasing demand for precision castings for military and electronic applications; Expanded markets for high alloy castings based on their use for high temperature service; With improved handling ability and better knowledge of the product magnesium castings will see greater use; An increase in ductile iron applications to exceed 5 million tons in the next 10 years.

Through improved planning and increased standardization, the use of automatic materials handling in the foundry will be greatly increased. Development of master adapter plates will eliminate much of the flask changeover that is now time-consuming and expensive.

Better sand control, through the use of new, fast devices for measuring the quality of return sand, will undoubtedly be developed.

The anticipated development and use of automatic core-making and mold-making machinery has hardly begun. Improved quality of the product, greater production per sq ft of floor space and greatly increased output at lower unit cost are made possible by the latest automatic core-blowing and automatic mold-making equipment.

While there have been some patent problems limiting general acceptance of ductile iron by the metalworking industry, indications are that, once all the legal problems have been settled, ductile iron will gain wide acceptance in this country.

The superior physicals available in ductile iron are certain to find many important engineering applications. By combining excellent as cast properties with good machinability, ductile iron provides an outstanding, new en-



gineering material. Tensile strengths in the steel range are available after heat treatment.

Shell molding, which lends itself readily to automatic processing, has hardly started. Once free exchange of technological information is established and the existing licensing situation is cleared, substantial gains are virtually certain to follow. The development of new, less expensive binders will speed up acceptance of the shell process.

Establishments equipped to make shell molds or shell cores on automatic equipment for outside foundry customers may find themselves with a new and important business. The future for shell cores, made on automatic equipment to close tolerances, looks particularly bright.

The prediction has been made that within a few years 30 pct of all gray iron castings made in this country will be produced using the shell process. Some observers place the total even higher.

The acceptance of permanent mold gray iron castings is expected to increase as their outstanding properties and opportunities for cost savings are more fully appreciated.

Rates of production of permanent mold castings even today are fantastically high while maintaining top quality and close tolerances.

Permanent mold gray iron casting is a long step in the chain of metalworking events that is pointing unmistakably toward automatic processing.

Larger die castings is the immediate aim of die casters to provide industrial manufacturers with large one-piece components ready for assembly. These larger die castings will help manufacturers lower product cost by providing components that do not require subassembling of parts. Smooth surface finishes, with accurate tolerances cast-in, can eliminate subsequent processing steps.

With the development of satisfactory equipment for making very large die castings, the market potential for die castings has been extended. The future of large die castings machines competitively will inevitably depend on (1) quality of the product, (2) ability to maintain a steady flow of parts, (3) cost of the machines, (4) comparative cost of the product.

Diecasting of ferrous materials still appears to be a long way off. However, this situation could change if ceramic-type materials or some other new die material should become available and machines could be built to handle ferrous die castings successfully.

Increased use of color anodizing of aluminum die castings will now give the decorative advantages which have been available to zinc die castings through chrome plating. This anodizing gives components a color finish that will resist weathering and fading due to the sun's ultraviolet radiations. In addition, newer die casting techniques permit pressure-type applications such as used today in automotive torque converters.

The largest gain in die casting production may come in magnesium where the recent development of a hot chamber process promises to bring magnesium into a competitive basis for many new applications.

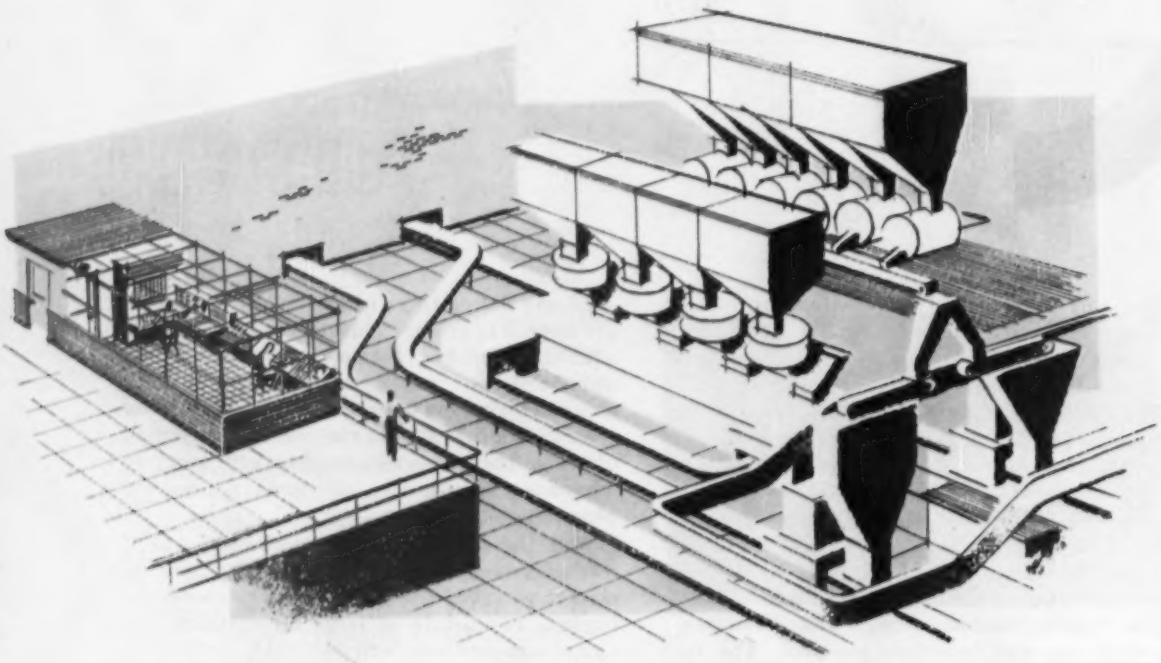
The present economic differences between wax, plastic and mercury patterns will be modified in the future with the perfection of "soft metal" dies to form frozen mercury. Ceramic shell molds for use with wax or plastic, to replace the solid investments will be perfected. The "booking die" technique, now used to form intricately detailed cores in mercury patterns, will be adapted for use with wax and plastics.

The future of the investment casting industry therefore lies in obtaining major improvements in metallurgical quality, dimensional control and costs. These objectives will be gained as the use of ceramic shell molds replaces solid investments and as controlled environment melting and casting replaces air equipment used in either melting or casting.

Dual metal centrifugal castings, with their ability to provide unique combinations of properties, are expected to find many new applications. Each combination of metals offers particular advantages for different applications. Opposition to the idea that dual metal casting cannot be economically used in competition with single metal castings is growing. This is particularly evident where weights are comparatively large and quantities are high.

Demands from consuming industries for high alloy castings are likely to increase as operating temperatures and pressures of today's industrial processes move to higher and higher levels. Many industrial processes are more efficient at higher temperatures and pressures; thus, high alloy cast components may help to achieve these higher levels.

New technological developments are also increasing the demand for high alloy castings. The requirements of nuclear and solar energy utilization, further developments in gas turbines and rocket engines, and other developments still in the embryonic stage, are expected to utilize cast high alloys to help solve problems of higher temperatures and pressures.



FOUNDRY OF THE FUTURE—based on low cost power, probably atomic. Molds enter pouring area behind wall at left, emerge on conveyor in foreground. Molding material is in hoppers, rear. Core making area is in center beneath hoppers which store plastic bonded core material. Patterns enter on conveyors from storage area behind materials hoppers. Castings go out on conveyor (right center) to cleaning.

Operation is designed to produce 720 molds hourly if demand warrants. Figure is made up of any combination of some 20 patterns which may be run at one time. Entire foundry is noise and air conditioned. Area under glass enclosed control room houses central computers and records.

Better castings for better end products . . .



achieved by

SHELL MOLDING with G-E SHELL RESINS

Examples like these show why so many foundrymen and casting buyers are turning to shell molding. Shell molding yields smoother, sounder castings—with greater dimensional accuracy—than conventional sand-casting methods. Are *you* taking advantage of shell molding for better castings for better end products?

Ask G. E. about shell molding

General Electric offers a number of foundry products to help you benefit from the shell process: *G-E phenolic shell-molding resins* to form light, dimensionally accurate molds . . . *G-E silicone parting agents* to secure quick, easy release of molds from patterns . . . *G-E phenolic bonding resins* to cement shell halves together.

FREE BOOKLET AVAILABLE

How can shell molding help YOU? General Electric maintains a shell-molding laboratory in Pittsfield, Mass., to help users and prospective users of shell molding solve problems and evaluate the process. Also, G. E. has prepared an informative 28-page manual telling about the techniques and benefits of this new foundry method. For a free copy of *G-E Shell Molding Manual*, just write to *General Electric Company, Section 522-4C, Chemical Materials Department, Chemical and Metallurgical Division, Pittsfield, Mass.*



Progress Is Our Most Important Product

GENERAL ELECTRIC



Quotes: 1855 — 1955

Abstracts from past issues of THE IRON AGE, *selected for their flavor, and with some regard for whimsy:*

Core Makers' Demands

The core makers have made a demand upon the foundrymen of Philadelphia for an increase in the minimum rate of wages from $2.50 to $2.75 a day for nine hours.

Sept. 14, 1905

Underwater Telescope

A new telescope for examining objects situated under water was recently tested on one of the French canals. Reports affirm that pencil marks could be clearly distinguished at a depth of five feet.

Oct. 24, 1867

Russian Trade Prospects

American manufacturers of machine tools and other classes of machinery affected will be highly gratified by the announcement made through official sources that Russia will soon publish an imperial ordinance providing for the abolition of the extra duties imposed on machinery imported from this country. This is highly important news coming at this particular time. It is believed that as soon as Russia's troubles are settled energetic steps will be taken toward building up Russian industries and that this will mean the purchase of a great deal of machinery, of which the United States manufacturers will undoubtedly be able to secure their share.

Sept. 14, 1905



A Dependable Source of Uniform, Quality PIG IRON



Woodward Iron Company is the largest independent and completely integrated company in the United States engaged exclusively in making merchant pig iron. It mines its own coal and ore on its own properties and hauls all its raw materials on its own railroads to its own furnaces. Properties of Woodward Iron Company comprise about 62,000 acres of coal and iron producing land including reserves vast enough to operate its present four furnaces at peak capacity until the turn of the century. Coal and ore mining operations are all located within a radius of 9 miles from the blast furnaces—a situation which is unique on this continent. Plants of Woodward Iron embrace every facility needed to produce quality pig iron. They include two modern coal mines, three red ore mines, four blast furnaces with an annual capacity of 772,632 tons of iron; a by-product plant which comprises 256 by-product ovens with equipment for recovering coal chemicals, and coal washing and screening plants. Woodward's transportation system comprises 52 miles of railroad trackage, 529 railroad cars and 12 locomotives. Founded 1882, Woodward has long enjoyed a national reputation for the uniform high quality of its merchant iron and the dependability of its service to customers.





Your inquiries are invited.

WOODWARD IRON COMPANY

WOODWARD, ALABAMA

HERE'S NEWS FOR IRON FOUNDRYMEN!

7 big improvements made available to industry by HANNA, best known name in iron . . .

HANNATEN

THE IRON INGOT WITH THE NEW SHAPE

FOR USERS OF 10-LB. PIGS



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- FINER GRAIN STRUCTURE
- MORE EVEN MELTING
- MORE ACCURATE CONTROL
- EASIER CHARGING BY COUNT
- LESS BREAKAGE
- EASIER HANDLING

Available in all grades and extra-close-grain HannaTite. (Standard 38-lb. pigs also available.)

THE HANNA FURNACE CORPORATION

Buffalo • Detroit • New York • Philadelphia

Merchant Pig Iron Division of

NATIONAL STEEL CORPORATION

Iron Pipe Troubles

The heavy fluctuations in the production of cast iron pipe, because of the alternation of bad and good times in this country, also the irregularity with which orders are placed for extension requirements of the large municipal water-supply developments, have tended to put out of business all those establishments that were not advantageously situated for either rock-bottom cost of supplies, or specially good shipping locations. Thus, while the Southern plants, located in the Birmingham district, have the advantage of cheap pig iron, coke and labor, those of the Delaware River can ship by water all over the world. To obtain a steadier production, individual manufacturers have tried to branch out into special lines—to have cast iron pipe replace steel pipe. Much of the conduit work in oil refineries is made of cast iron; for corrosive waters, even where high pressure is involved, cast iron does better than steel; and for some purposes cast iron pipe is now furnished with a cement lining.

Sept. 18, 1924

Fire Risk of Steam Debated at Meeting

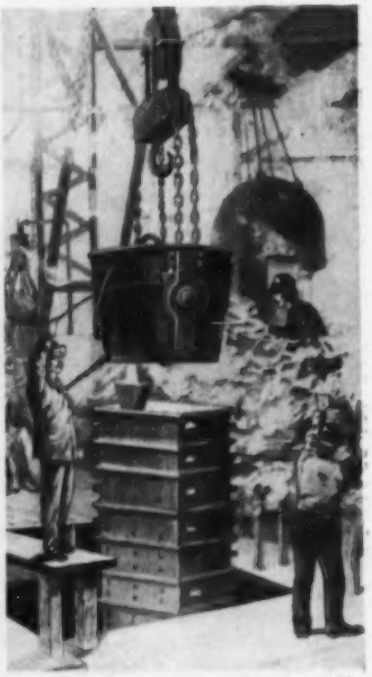
On Friday evening a meeting of the Polytechnic Branch of the American Institute was held in Cooper Institute to consider the question of the danger of conflagration resulting from the presence of superheated steam and pipe when contact with woodwork is permitted.

Prof. Van Der Weyve opened his remarks by saying that the condition of the question was at the present time the same as it had been when it was first introduced to the public. He referred briefly to the period when gas was first used to illuminate cities and the great noise which was then made by alarmists in regard to the dangers by which it was attended. Now all those futile fears were obsolete and accounted silly. It was so with steam as a means of radiating heat through buildings. There was now raised the cry against it. When properly understood it would be found to be safer than any other medium. He deplored the fact that some persons were driven by prejudice to ascribe every fire which occurred to the heat of steam itself. Mr. Wiard then took the floor in support of his theory citing numerous instances from the experience of various engineers of combustion supposed to have been caused by superheated steam.

Roof Set On Fire

Fire Marshal McSpedon said that since the discussion of superheated steam had begun an example of the truth of his theory had come in a very apropos manner under his notice. In the Harlem Gas Works the roof had been set on fire by the contiguity of the steam whistle with the wood.

Jan. 23, 1873



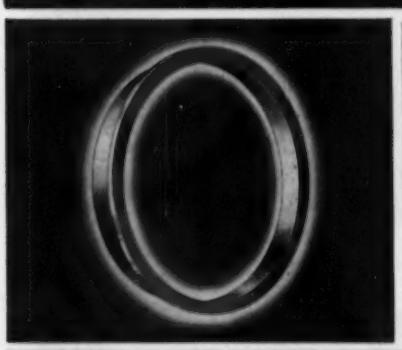
Bettman Archive

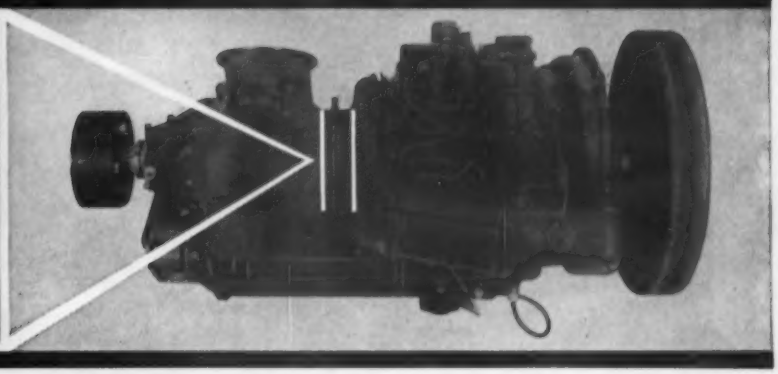
CASTING an artillery piece at a Pittsburgh mill. From an 1888 engraving. Note ladle and cranes.

BOEING chose LEBANON

...to make the STAINLESS STEEL CASTING for the powerplant of a JET TRUCK









The Lebanon Circle (L) Casting in the Boeing 502 Gas Turbine is a product of the Centri-Die process. The complete story of this and other Lebanon Centrifugal Castings is told in a 12-page brochure. Copies are available by writing to William H. Worrilow, Jr., General Sales Manager, Lebanon Steel Foundry, 71 Lehman Street, Lebanon, Pa.

ON the highways of the Far West a 25-ton trailer truck has been powered more than 60,000 miles by a midget engine weighing only 240 pounds!

Midget in size but mighty in power, this revolutionary new power plant is the BOEING 502 Gas Turbine, developed by Boeing Airplane Company as a test model that has wide significance for the entire field of vehicular propulsion.

At the heart of the Boeing 502 is heat—searing, power-packed heat of over 1500°. Surrounding, containing and resisting this inferno is a stainless steel casting especially selected for the job—a LEBANON Circle (L) Casting, made at Lebanon Steel Foundry by people who, with Boeing, are looking toward the future.

CIRCLE L ®

LEBANON STEEL FOUNDRY

LEBANON, PENNA.

Carbon, Low Alloy and Stainless Steel Castings

NOW--LOOK TO CHIEF SANDUSKY FOR FERROUS TOO!



★ CHIEF ★
SANDUSKY

FERROUS AND NON-FERROUS CENTRIFUGALLY CAST ROLLS, SLEEVES, LINERS, TUBES, CHUTES, RETORTS, BUSHINGS, BEARINGS, RINGS, ETC.

With the recent installation of high-frequency induction melting furnaces, Chief Sandusky now supplies industry with a diversified line of both ferrous and non-ferrous cylindrical castings. In addition to the convenience of single-source supply, we provide sound technical assistance from both the field and greatly expanded laboratory facilities.

With a skill born of 40 years' experience, time tested in hundreds of plants, you can call on our experienced technicians with confidence. They're ready to help you with manufacturing special castings to specification or working with your staff in developing unusual types to solve new problems.

Look to Chief Sandusky as a continuing dependable source of both ferrous and non-ferrous custom quality centrifugal castings.

C. M. LOVSTED & CO., SEATTLE, WASH. • TYNES BROS., BIRMINGHAM, ALA. • CORDES BROS., SAN FRANCISCO AND WILMINGTON, CALIF.

SANDUSKY
FOUNDRY and MACHINE CO.

615 W. Market Street Sandusky, Ohio

Lift Restrictions On Russian Trade . . . But

While restrictions on trading with Russia have been lifted, Government officials do not expect any considerable resumption of commercial activity. American exporters have been expressly warned of risks involved, and they have been told that they could expect no assistance from consuls or aid in facilitating credit arrangements. . . .

The State Department, announcing the lifting of restrictions, makes it clear that the Department will continue to refuse to issue passports to Russia, and that the Post Office Department will not enter into any relations with the Soviet postal authorities. It will continue to be impossible to forward mail to Russia or to receive mail from Russia. There never has been any parcel post convention between the United States and Russia and this method of forwarding goods is not available.

The statement made it clear that the United States has no intention of granting political recognition either now or in the future to the Soviet Government.

July 15, 1920

New Reaper Works

The works of C. H. McCormick & Co., manufacturers of the celebrated McCormick reaper, at Chicago, are entirely new, the former establishment having been burnt during the great fire. The present brick building is five stories high, 350 feet long, and is in form like the letter E, the wings being 600 feet long. The machinery is driven by a steam engine of 300 horse power. The precautions against fire in this building are of a very perfect character. It is believed that at least 10,000 reapers will be completed before the harvest of 1873. About 600 workmen are now employed. The two cupola furnaces melt daily 40 tons of pig iron, and about five tons of wrought iron are used in the blacksmitn shop.

May 8, 1873

How can you use Monarch's new

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to improve your products?



Here is a revolutionary new finish—pioneered by Monarch—for users of aluminum castings. Could this be your solution to problems involving colorful sales appeal and surface protection? Certainly such an outstanding new development is worth your investigation.

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THERMENOL CASTINGS*

Our service to industry in connection with the chrome iron, chrome nickel and nickel chrome castings is based on several important factors:

- **Extensive knowledge of the behavior of the so-called high alloy castings under operating conditions involving corrosion, temperatures and abrasion in all combinations.**
- **Wide experience in selecting the proper alloying elements and subsequent heat treatment so that each casting will give maximum service.**
- **Modern, well equipped foundry operated by highly skilled alloy casting specialists. Tied in with our foundry facilities are 400,000 volt X-Ray and Gamma Ray test units; close metallurgical alloying and heat control; sand testing, and complete machine shop facilities.**

Any one facet without the other two would be of little value; combine all three as we at Duraloy can offer, and you will have every reasonable assurance that your castings will be correctly alloyed and soundly cast.

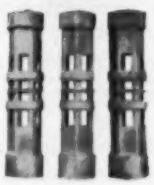
We'll be glad to quote on your requirements and, if desired, help in selecting the best combination of alloying elements to meet your operating requirements. For the latter, send us as complete information as you can.

* **The Duraloy Company has been granted an exclusive license for the manufacture and sale of castings of the new alloy known as THERMENOL, covering all states east of the Mississippi River, including Louisiana, plus Minnesota, Iowa, Missouri, Oklahoma, Arkansas and Texas.**

THERMENOL, containing no nickel or chromium, has excellent resistance to oxidation and sulphur bearing gases at very high temperatures. Tests at 2200°F. show practically no oxidation. High electrical resistance, and excellent magnetic properties. Up to 20% lower density than most stainless steels. Further information on request.

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By PERMANENCE RESISTANCE DURALOY DURABILITY **one of the Country's HIGH TONNAGE Producers**



Sleeves for vibrating hammer, non-magnetic, 18% chromium, 8% nickel



Corrosion resisting stand, an 18% chromium, 8% nickel alloy



Annealing retort for 1700°F. centrifugally cast tube sections welded together



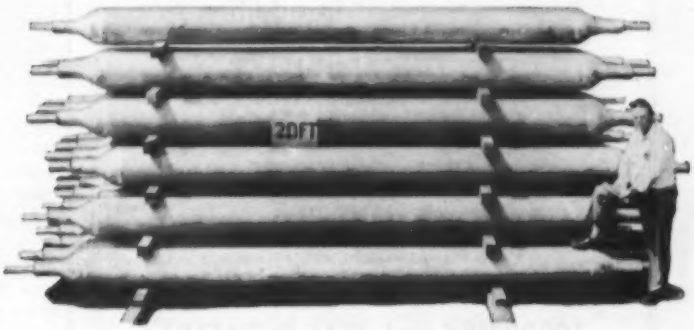
Heat-resistant alloy casting for heat treating furnaces; 35% nickel, 15% chromium



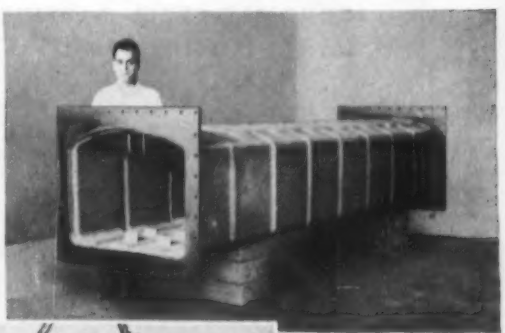
Cement kiln flights; a 28% chromium, 10% nickel casting



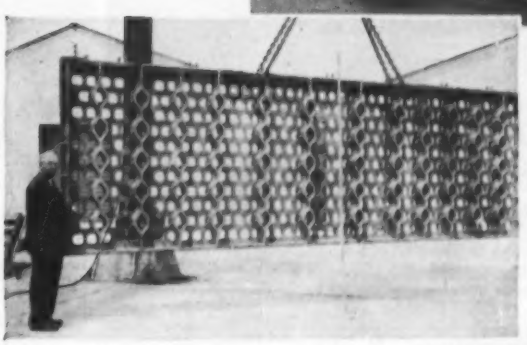
Carburizing furnace fixture; 35% nickel, 15% chromium



The tubes are 20 feet long with 14" OD. They have a ¾" wall thickness and weigh 1250 pounds each.



Several sections welded together. Total length: 12'6"; cross section approximately 24 inches square; weight 4500 pounds.



Three separate castings welded zig-zag across the face. Total length: 21'6"; width: 6'7"; weight 8900 pounds.



Have you a copy of our New General Catalog? It goes into much more detail about our work; also gives a lot of useful information about high alloy castings . . . Send for as many copies as you would like for distribution in your own organization.

THE DURALOY COMPANY

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The King PORTABLE BRINELL is guaranteed to make Brinell tests of the greatest accuracy on large and small parts of almost any shape. In addition, this versatile unit:

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ACKNOWLEDGMENT

In addition to those mentioned in the text or in photo credits, the editors also want to thank the following for their help in preparing this section:
W. E. Dougherty, Giffels & Vallet, Inc.; Davidlee von Ludwig, consultant; Alloy Casting Institute; American Foundrymen's Society; American Wheelabrator & Equipment Corp.; Buick Motor Div.; Cadillac Motor Car Div.; Climax Molybdenum Co.; Eaton Mfg. Co.; Ford Motor Co.; Gray Iron Founders' Society; International Nickel Co.; Jeffrey Mfg. Co.; Malleable Founders' Society; National Foundry Assoc.; Newcomb-Detroit Co.; Non-Ferrous Founders' Society; Pioneer Engineering Works; Pontiac Motor Div.; Simplicity Engineering Co.; Society of Automotive Engineers.

Pearlitic Iron

In 1910 I was instrumental in producing an ordinary gray iron that could be tempered. I made tool steel quality bars out of ordinary commercial gray iron, annealed them, machined them into form tools, rehardened them until in those days the hardness reading showed that they were harder than any steel on the market, and I used them for cutting cold rolled steel and I cut bands on shells with excellent results, except that they were extremely brittle and would snap under shock.

Then, a year later I found that this same cast iron, when treated, would take and retain magnetism the same as steel, and hold it longer. Coming up to 1923, a new process of heat treatment was developed, where, by the heat treatment of cast iron, there is imparted to it some of the qualifications of malleable iron. I was connected with a company for a period of time where we produced—I am not exaggerating—cast iron bars that we could bend cold 30 deg.

The English Accepted It

So, once again, we find the lowly cast iron, when properly handled, possesses some of the attributes that belong to steel. A company was formed to promote that heat-treating process, but almost immediately it was abandoned because we discovered that the Germans, starting with so-called pearlitic iron, were doing all we could do and straight from the cupola without any heat treatment. They came over here two years ago and tried to interest American foundrymen. First they took their process to England and the English accepted it. . . .

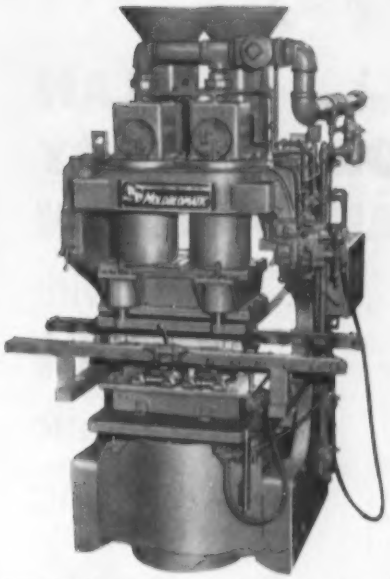
I saw some of the tests made on pearlitic iron at Columbia University; I saw a 1¼-in. pipe nipple put under hydrostatic tests. If we took such a nipple made in the ordinary way, we would test it to 250 lb pressure. I saw those nipples tested to 2010 lb, when the pressure blew the gasket out and could not go higher, and that iron was poured direct from the cupola and with no additional metal.

Those Germans toured the country, talked to a number of the men here and tried to interest them in pearlitic iron. To be sure they charge a royalty. Whether or not it was the aversion to royalties, we do not know, but we do know they went back without succeeding in introducing it in a single place in this country. They continued their efforts in Europe, and France took it up, as did Italy, Denmark and even Czechoslovakia, and down in Brazil they adopted it, and still the United States, as far as I know, has done nothing.

E. A. Custer, Jr.
Nov. 24, 1927

MECHANIZATION has changed the face of the foundry industry

Few industries have undergone so complete a face lifting in the past few decades as has the foundry. With vastly improved working conditions and greatly increased productivity has come a new era of higher quality and greater casting adaptability. Largely responsible for these changes is the advanced equipment that has been made available to large and small foundries alike. Beardsley & Piper has been in the forefront in providing such equipment for molding, coremaking, sand preparation and shell molding. Future progress is dependent only on the foresight and inventiveness of foundrymen and the equipment industry that serves them.



B&P MOLDBLOMATIC machines provide new standards of efficiency in producing molds on a high production basis. By blowing molds, many of the time consuming operations necessary with other methods are eliminated. Yet, high quality and uniformity are assured, with the elimination of human error.



B&P HYDRA-SLINGER ROTO-MOLD units for the first time bring the advantages of fully-rigged production operation to foundries making a wide range of miscellaneous molds. With such units fully mechanized molding operation is no longer restricted to production foundries.



B&P SPEEDMULLOR-PREPARATOR UNITS designed primarily for the jobbing foundry mark a new turning point in the industry. Now, all of the benefits of fully controlled sand are available at low cost to jobbing foundries—large and small. Control means higher quality with greater uniformity, economy, dependability.

Manufacturers of advanced machinery for the foundry industry

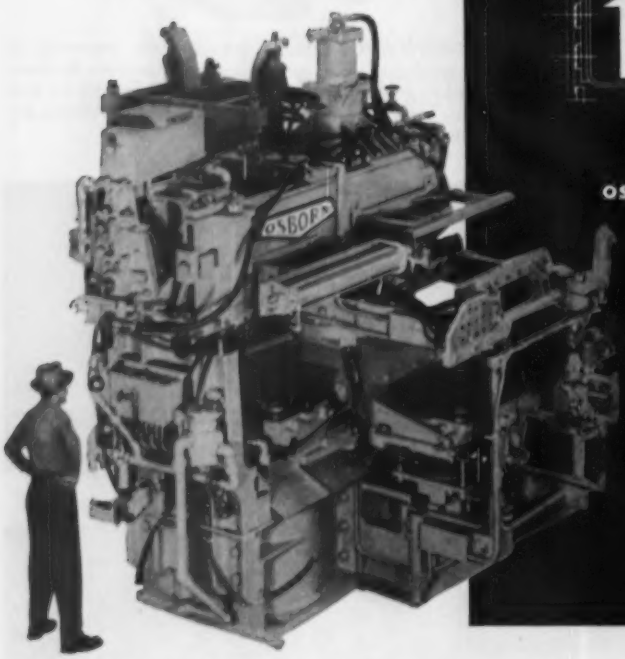
Sandslingers, Speedslingers, Hydra-Slingers, Swing-slingers, Speedmullors, Speedmullor-Preparator Units, Mulbaros, Lab Mulbaros, Roto-Mold Turntables, Roto-Feed Plate Feeders, Screenarators, Magnarators, Junior Nite Gangs, Nite Gangs, Portable Preparators, Flexible and Flexiblomatic Moldblowers and Coreblowers, CR and TR Cormatic Units, B&P Rol-A-Draw, and Jolt Rol-A-Draw Machines. Shell Mulbaros, Shell Speedmullors, Formatic and Biomatic Shell Molding Units, Champion Molding Machines, J&J Molding Machines and a complete line of automatic control equipment including Biomatic, Mulitrol and Mulitrolmatic.

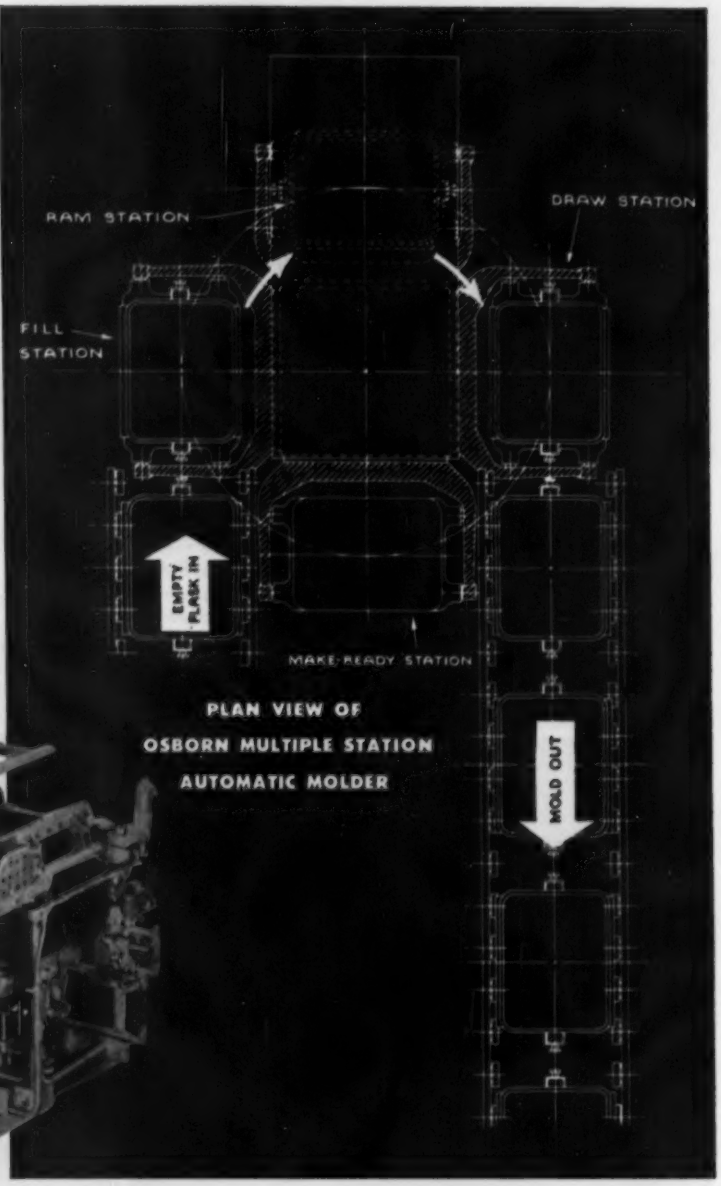
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PLAN VIEW OF OSBORN MULTIPLE STATION AUTOMATIC MOLDER

NOW ... *finished half molds automatically* ... *at rates of 180 to 240 half molds per hour.*

UP to 240 half molds every hour, hour after hour. That's the production you can attain with this Osborn Automatic Molder. Sand is fed into one side of the machine, finished half molds are delivered from the other side right to your pouring line. Molds are uniform in size and density. Less training is needed to produce quality molds. Cost of production is less.

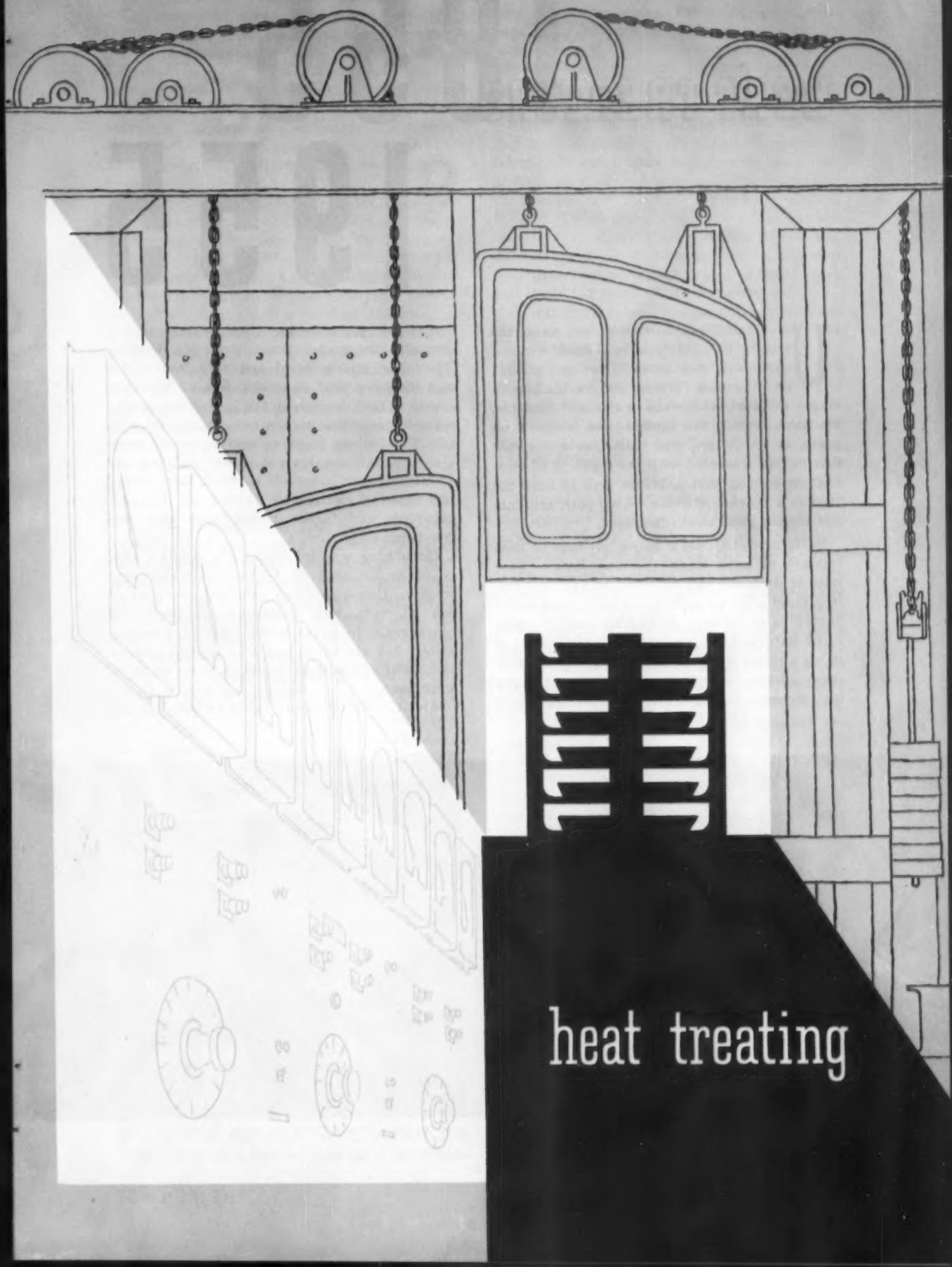
Call for an Osborn foundry specialist to study your foundry operations. He can show you how to save money on producing molds and cores on both small and large quantity runs. Write The Osborn Manufacturing Company, Dept. FF-29, 5401 Hamilton Avenue, Cleveland 14, Ohio.

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MOLDING MACHINES CORE BLOWERS
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100 YEARS OF METALWORKING



heat treating

HEAT TREATING 1855 1955

UP TO 1862 little was known about the science of heat treating. Heat treating equipment was crude. Heating for heat treating and forging was in blacksmith forges and coal, coke, wood or charcoal furnaces. Furnaces used a firechamber over a cast iron grate, in which steel was heated, or a separate firechamber was used with the products of combustion passing over a bridge wall to heat the steel in a heating chamber. Lead pots, salt pots and molten glass were often used.

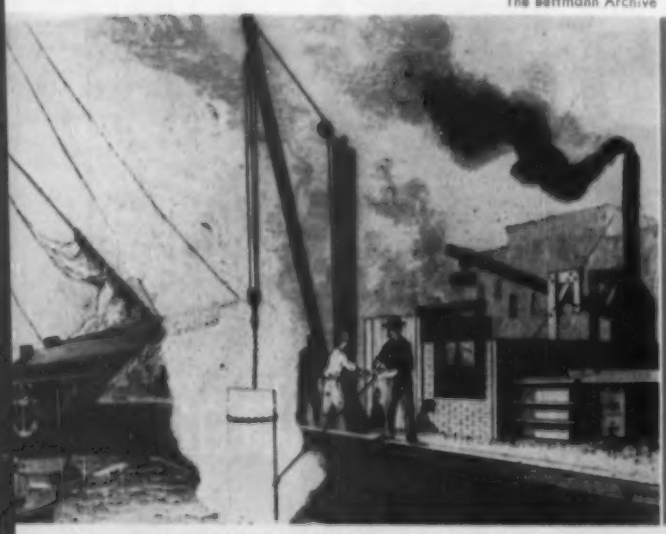
Surface scaling was a major problem to heat treaters of early days. Various devices were tried to overcome this problem. In one instance, iron pipes acted as muffles in a forge used in the hardening of cutlery. In another case, the part to be hardened was covered with platinum foil in an attempt to overcome scaling. In spite of these efforts, very little of a positive nature was accomplished in licking this problem.

Tempering was accomplished in several ways. Probably the most common was color drawing. The piece was polished and held over a fire and the color used as guide. Hot oil was used either in bath form or in the case of one spring manufacturer the parts were actually fried in oil. The boiling point as well as smoke emission was the temperature guide. In other applications parts were oil covered, then heated until the oil charred or burned off. Candles, blowpipes and fusible metals were also used for tempering.

Quenching was in almost any medium that could be dreamed up by the particular heat treater. One quenching solution consisted of fish oil, suet, wax, neats-foot oil, pitch, and black rosin in equal parts. Mostly, however, water, fish oil, brine and also mixtures of oil and water either in agitation or as oil on water were used.

About 1880 petroleum oil and natural gas

The Bettmann Archive



HARDENING of steel plates in 1895 was done by dipping them at red heat into Hudson River.

Carborundum Co.



BOX FURNACES, salt baths and oil draw pots were in use in the heat treating shop before 1920.

were being used for heating. Producer gas was used for some heavy applications.

The consistent study of steel heat treating began in 1862, when Sorby applied systematic use of the microscope to the study of steel, Tchernoff detected the occurrence of definite changes where steel would harden and Barrett and Gore found that critical points were involved in the hardening of steel. The invention of the thermocouple and pyrometer by Le Chatelier was a great help in the study of metals.

The work of Sorby, Tchernoff, Wedding, Osmond, Martens, Mushet and others continued to develop information on the properties of steel from 1875 to 1885. An IRON AGE editor of the time, J. C. Bayles, was strongly advocating the use of the microscope to support chemical and physical analysis on steel and iron.

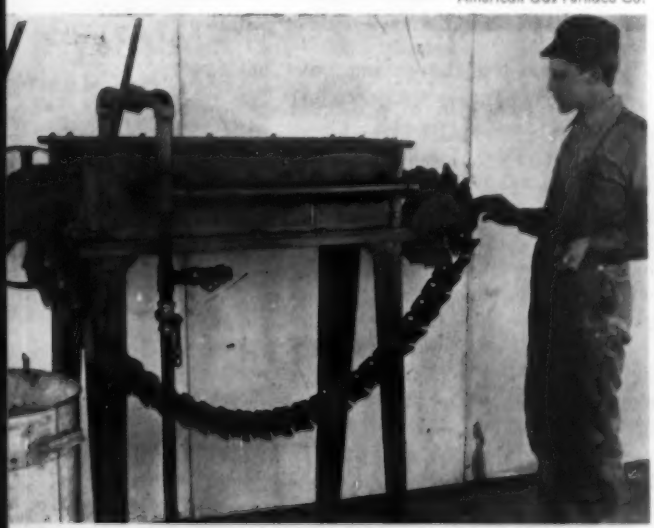
The first organized research into the theory of iron and steel was undertaken in 1880 by The (British) Institute of Mechanical Engineers who met in Paris to consider the hardening, tempering and annealing of steel. It was during this time that Tchernoff revealed his crystalline theory that began a lively period of discussion in the heat treating of steel.

Forced air entrains gas

A new method of burning gas about 1870 revolutionized gas heating. Bunsen's principle up to this time was the most common. In Bunsen's method, the gas drew in the air for combustion. The new method used forced air to entrain the gas and thus was much more efficient and produced a greater volume of heat with much better control.

About this time, many coal and wood burning furnaces were being converted to oil. The conversion was a relatively simple operation. Coal burning fire chambers were made smaller and most doors were sealed. Oil burner ports were installed in the walls of the fire chamber, but in some cases, oil burners were installed directly in the heating chamber. At first, compressed air atomized the oil. Later, the air was supplied by blowers.

American Gas Furnace Co.



CONTINUOUS type gas furnace was used to heat treat mower parts before the turn of the century.

About 1900 Roberts-Austens devised the first iron carbon diagram. This was immediately followed by much work dealing with the solidification of steel and iron and transformation in heating and cooling. Roozeboom applied Willard Gibbs' phase rule to the iron carbon reactions in steel. Henry Marion Howe was correlating much of the metallurgical information from Europe with his own original work and clarifying much of the nomenclature.

Albert Sauveur was applying the microscope to every day problems in steelmaking at the Illinois Steel Co.

His paper, "Microstructure of Iron and Steel," presented to the American Iron and Steel Institute, established him as the leader in the field at the time. He also was perhaps the first consulting metallurgist in America. The first metallographic instruments in this country were assembled and sold by him.

Because of the automotive industry's quality requirements many of the larger steel companies at this time were adopting the microscope for their research, control and development problems.

Machines for physical testing began to arouse interest about this time. A major contribution to the science of heat treating was the hardness tester developed by John August Brinell. This device was later followed by the Charpy and Izod impact testers and the sceleroscope by Shore and Breuil. Still later came the Rockwell tester. All of these instruments greatly assisted the heat treater.

Frederick Taylor and Maunsel White discovered, then developed, the chromium-tungsten high-speed tool steels. Their work on these steels virtually revolutionized the art of machining in those days.

The automobile's demands for light weight and quality spurred the scientists and the practical heat treater to renewed efforts in the next ten years. The automobile companies also installed testing and research equipment. The first use of many of the present heat treating processes were developed.

Gas carburizing was invented in 1906. Nitriding was developed and patented in 1913. Several continuous type furnaces were on the market at this time including rotary retort types, conveyor and pushers.

Gas carburizing greatly advanced the process of carburizing and made possible the continuous carburizing of steel. Pack carburizing, however, was still a widely used method. Automatic control of furnace temperatures was first

used in this period as well as an atmosphere gas producer. Full muffle furnaces came in with the use of gas and electric heat and atmospheres. The electric furnace was another great advance in this decade.

The period from 1915 to 1925 was characterized by fast production equipment including the car, conveyor and box furnace that would heat fast and produce large quantities of work.

Car furnaces developed from a stationary floor level hearth that was loaded either by pushing the work on the floor or on skid rails to complete and separate cars. These cars rolled on large metal balls, and later developed to cars that used wheels and axles. Silicon carbide or Nichrome muffles were being used in many processes.

Salt baths were becoming popular in the latter part of this period. Furnaces for this type of heat treating were developed to use electric heating, gas or oil. Cyanide hardening was used to a great extent for hardening parts of small section. Later, activated cyanide baths were developed that increased the use of this method. Neutral salts were used for straight hardening of alloy and high carbon steels.

Some of the technical developments were the work of Portevin and Garvin on critical cooling rates which was probably the beginning of the immense amount of work that developed into the hardenability research in later years. An alloy steel designed specifically for nitriding was developed and did much to promote the nitriding process.

New equipment improved combustion

Research in combustion was responsible for many improvements in fuel use. An automatic air-gas proportioning system was one of the developments, powdered coal was being used in the malleable industry and oil burning equipment was improved.

The use of induction heating was in the experimental stages, having been suggested by Northrup as a means of industrial heating in 1917.

Short cycle malleablizing was reported possible in 1924. Electric heating was used in the annealing of tool steel bars, replacing a coal fired furnace. Also a two chamber high-speed heat treating electric furnace was one of the new developments in the middle twenties.

An oil fired continuous furnace that included a quench and draw for heat treating automobile axles was in use. A coal fired furnace for malleablizing required no packing in the boxes. The complete malleablizing cycle was accomplished in 10 days.

A novel and important type furnace developed and used in this period was the hump heat treating furnace which actually showed the critical temperature on the recording chart and made hardening of steel much more uniform when controlled and guaranteed hardenability was not at the highly developed state that it is today. These furnaces used the actual critical of the particular piece of steel rather than a calculated critical.



W. S. Rockwell Co.

OIL-FIRED box furnaces annealed strip and coil stock in the New England brass mill of 1916.

An important furnace development was the use of a fan in a draw furnace. This type of heating did much to improve uniformity of low temperatuure heating and to speed the process.

Between 1925 and 1935 refinement and development of basic heat treating processes were important factors. Furnaces were being made that were specifically designed to take advantage of introduced atmosphere. Gas tight shells were the order of the day. Methods of conveying work through the furnace were improved.

Forced convection gave uniformity

Forced convection of protective as well as surface treating gases greatly improved heating, carburizing and nitriding processes both from a standpoint of uniformity and efficient production. Gas carburizing, liquid carburizing and cyaniding were fast replacing older methods of pack carburizing. Case hardening with ammonia gas and a carbonaceous gas was patented.

Grain size control became a firmly established factor in the heat treating of steel. Considerable interest in the age hardening properties of steel was shown in this period. The use of molybdenum to replace much of the tungsten in high speed steel was an important development.

New methods of producing silicon sheet brought new advances in heat treating and furnace design. A roller hearth electrically heated



Leeds & Northrup Co.

GEAR TREATING setup in 1920 included three hump furnaces and one electric draw furnace.



The Electric Furnace Co.

COILS of copper tubing enter an electric controlled-atmosphere furnace to be bright annealed.

furnace for atmosphere normalizing and annealing silicon sheet was in production in the early 1930's.

New liquid carburizing and liquid nitriding practices were established around 1934. Activated salt baths for carburizing were improved considerably and their use increased.

From 1935 to 1945 work on hardenability progressed to the point where calculations were predicting hardness with good accuracy. Steels could be ordered by hardenability specified in terms of hardness and depth of hardness.

The Sheppard PF test was developed. The Jominy hardness test made possible easy testing of commercial steels. The development of transformation diagrams, austempering, martempering and application of TTT curves to annealing both speeded the operation of heat treating and increased the quality of work.

The triple alloy, NE steels, brought on by war scarcities were important in heat treating metallurgy. War also brought problems that necessitated better heat treating equipment. Boron as an additive to steel proved itself in increasing physical properties in carbon and low alloy steels.

More, better and larger furnace equipment was developed and put to extensive use. Many types of continuous furnaces for bright annealing and bright hardening were in use. Conveyors consisting of pusher types, belt conveyors, chain, reciprocating or vibrating hearths, rotary hearth furnaces and batch furnaces were improved considerably. Pit types were in common use, car furnaces, elevator box and bell type furnaces were used for many operations. These took advantage of various types of atmospheres. Automatic recording of atmosphere dew points was an important development.

Induction hardening, which up to 1935 was an experimental process in heat treating, began a spectacular rise in heat treating and other heating processes. One of the first heat treating applications was crankshafts.

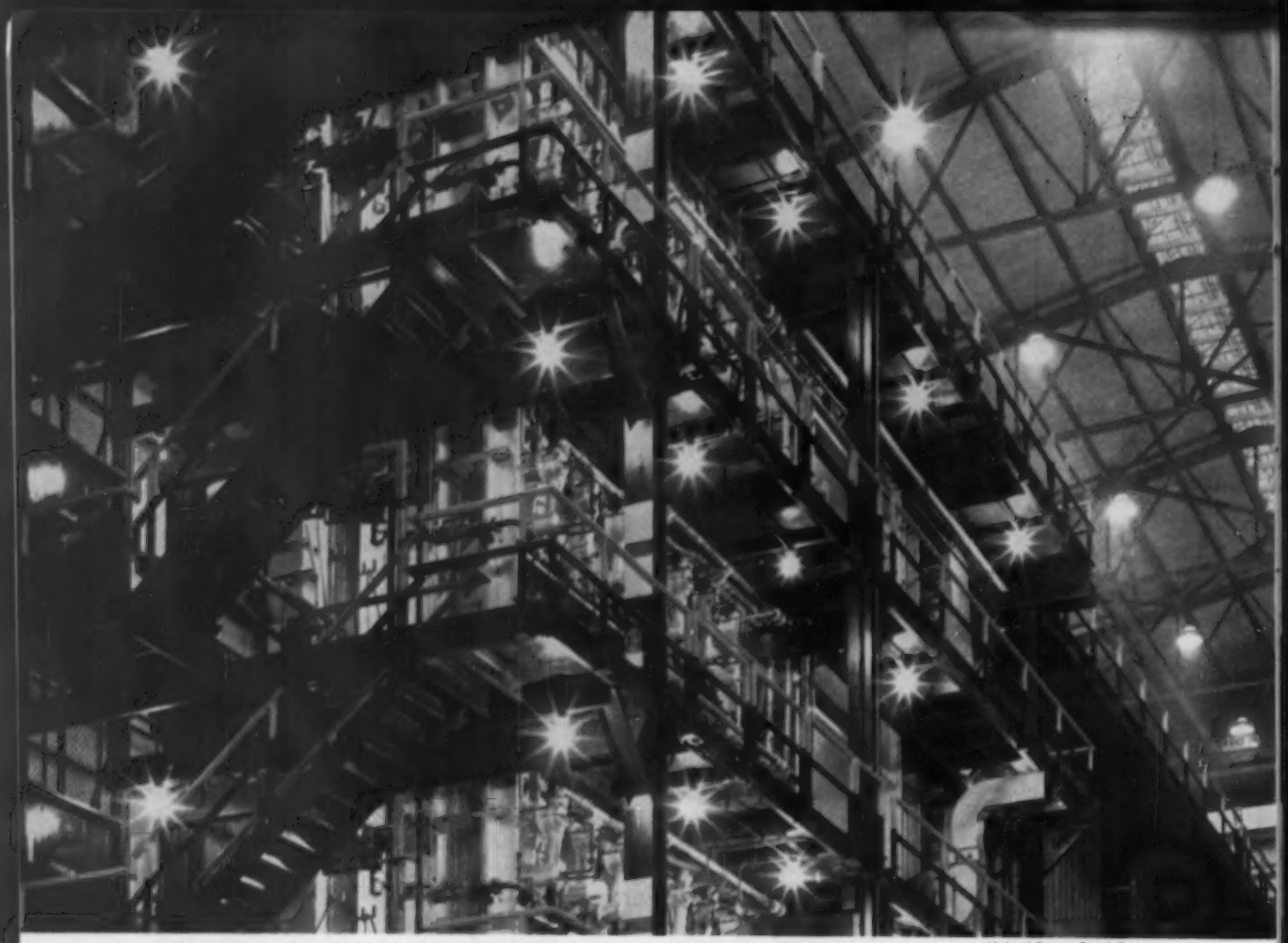
Flame hardening was mechanized and improved with the use of modern gases and techniques. The process has found wide application as a means of differential hardening. Electrode salt baths, in various stages of development earlier, were much in use for heating many of the commercial alloy and tool steels and were one of the most popular methods of heat treating high speed steels.

Cold treating of heat treated steel at subzero temperatures was introduced.

In the past 10 years advances in new heat treating processes and equipment include continuous vertical strip annealing furnaces.

Carbon levels maintained

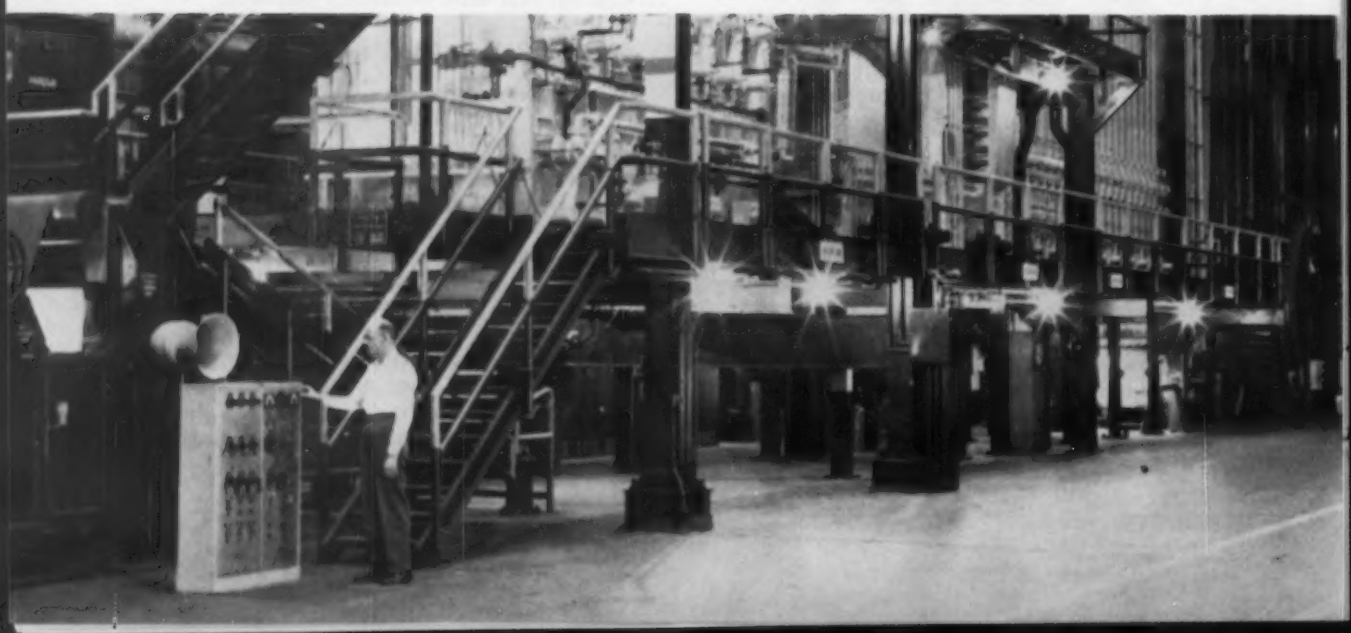
Carbon restoration of decarburized steel to exact carbon levels equal to original carbon content and homogeneous or through carburizing is also general practice with the new systems of controlling atmospheres. Furnace builders are furnishing units that operate automatically through all of the stages of heat treating. All that is needed is to set dials, load the furnace and push buttons for a complete, precise job. Parts can be treated so that they are never in contact with unwanted atmosphere from the time they are charged to the time that they are completely hardened. Malleablizing in new atmosphere furnaces has shortened cycles from weeks to hours.



United States Steel Corp.

HUGE heating units
built by Surface Combustion
and GE bright anneal strip
for tinplating.

HEAT TREATING...





THE FURNACE TODAY holds a position of outstanding importance as an essential "machine" in the manufacture of metal parts. As other machines form or shape metals to change their outward appearance, the furnace "forms" the inner structure and changes the properties of metals. Increased awareness of how these changes are achieved, as well as what these "machines" can do, has in recent years made the furnace a vital factor in the equipment or methods planning of almost every metalworking organization.

During recent years, a number of trends have been evident in the heat treat departments of metalworking plants.

1. Every reasonable effort is being made to control as closely as possible time-temperature-atmosphere relationships.

2. Quenching practices are being critically examined.

3. Unnecessary use of alloying elements that might become critical during a period of national emergency has been avoided.

4. The use of induction and salt bath heating has increased.

5. Careful consideration has been given to the selection of steel composition, quenching temperatures and quenching media so as to minimize distortion and eliminate, if possible, subsequent straightening or grinding operations.

6. The trend toward automatic handling is growing rapidly.

While the fundamentals of the response of steel to thermal change have been adequately understood for years and no important new principles have been discovered recently, consistent technological progress has been made. In part, this progress is due to improved furnace design which permits the operator to achieve better and more consistent results from heat treating.

Studies aimed at developing isothermal diagrams are probably not as numerous today as in the recent past. However, the use of isothermal studies of austenite transformation as a simple, readily understandable guide to heat treatment is increasing. Isothermal diagrams showing the effect of a particular alloying element or a combination of elements or of austenite grain size and homogeniety are used much more today than in the past.

Better understanding of the principles of heat treatment, coupled with improved control devices and new facilities for handling parts automatically have resulted in increased production of steel parts to increasingly restricted specifications, usually at lower cost.

To avoid unnecessary handling and to eliminate certain processing operations, metallurgists are getting away from double carburizing treatments. By carburizing at the usual high temperature, say 1700°F, then dropping to some lower level, say 1550°F, the case which is sluggish at this temperature, is held in solution.

Using this technique, distortion and undesirable carbide precipitation are minimized. This practice gives optimum properties at minimum cost.

This treatment is also widely used to eliminate retained austenite. In many instances where a rich case is formed during carburizing, quenching from 1700°F will produce a soft case due to excessive retention of untransformed austenite. Lowering the temperature before quenching forms a higher percentage of martensite, thus giving a harder case. This treatment is also used to precipitate carbides.

Undoubtedly the most talked of phase of gas carburizing and controlled atmosphere heat treating during the past few years has been the development of automatic analyzing equipment. Although such equipment has been used for some years, its application has thus far been limited to certain types of atmospheres where an accurate result could be obtained and relied upon. Still in the very early stages of development are the new gas analyzers to be used in carburizing and carbo-nitriding.

It has been established for some years that heating steel in the presence of a neutral carrier gas plus methane and ammonia can produce desirable results, ranging from carbon restoration or superficial nitriding to fairly deep and complex cases. The result, of course, depends on the gas mixture and the heating cycle. Such results can be regularly accomplished through carbo-nitriding under proper control, with minimum distortion of the piece.

One of the early efforts to use the carbo-nitriding process occurred in 1935. At that time, a non-decarburizing furnace was built for one of the large motor car companies. This furnace was able to restore carbon on the surface when hardening axle shafts. Later, a gas generator was patented covering the making of a gas whose principal constituents were carbon monoxide, hydrogen and nitrogen.

Subsequently, similar furnaces were built to put a light case on transmission gears. Today, carbo-nitriding embraces three major classes of work: (1) General work requiring case depths of 0.002 in. or more. (2) Work subject to excessive distortion on heating and quenching. (3) Work requiring a hard surface and an annealed core. The first classification includes perhaps 90 pct of the work being done.

In most modern heat treat shops, the trend is to hold case carbon, whatever process may be used, within narrow limits. Pack carburizing has largely disappeared as a volume production method. Gas carburizing, which utilizes a carrier and a source of carbon, is becoming increasingly popular.

Particularly in the automobile industry, it has often been found advantageous to hold carbon



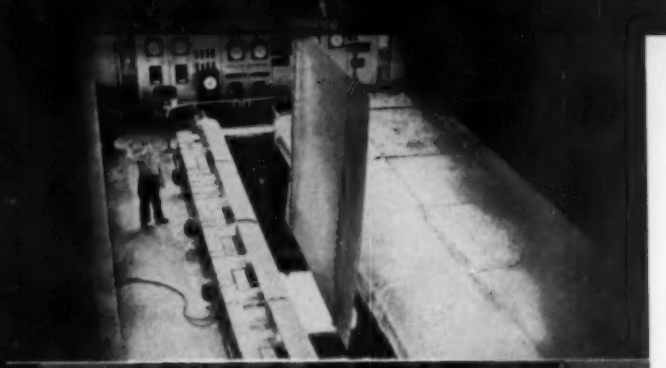


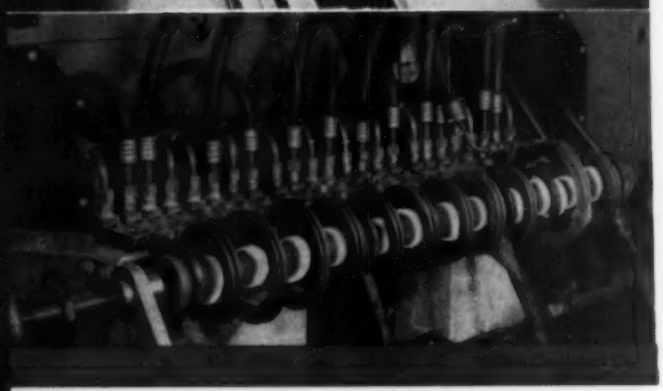
on the low side, say between 0.85 and 0.90 pct. Low carbon gives increased hardenability as well as high hardness. Decreased retention of austenite is also reported.

In the same industry, the trend is toward alloy conservation. Use just enough alloy—and the right alloy—for the job, seems to be the watchword. Increased use of sealed hot oil quenching and hot salt quenching is apparent.

The contention that steels are 100 pct equivalent if their hardenabilities are identical is being critically examined. The feeling exists in some metallurgical circles that there may be as yet undetermined minor differences between steels having the same hardenability characteristics.

Automatic handling of parts through the heat treat department, while it has already made tremendous progress, is rightfully getting increased





1 LOW CARBON coils in stacks weighing 60 tons are annealed in this circular bell furnace.

2 MILL PINION weighing 7 tons gets a hard surface on its teeth by flame hardening.

3 Top: MAMMOTH salt bath descales stainless clad plate at the rate of 30 tons per hour.

3 Bottom: CAMSHAFT hardening by induction heating is completely automatic and selective.

4 CONTINUOUS belt-conveyor furnace sinters powdered metal compacts at up to 2050°F.

5 SIX gradiation furnaces for short-cycle annealing are paired to easily vary production rates.

attention. Manual handling is being replaced by less laborious, and often less dangerous, mechanical handling. The trend toward automatic handling is expected to accelerate.

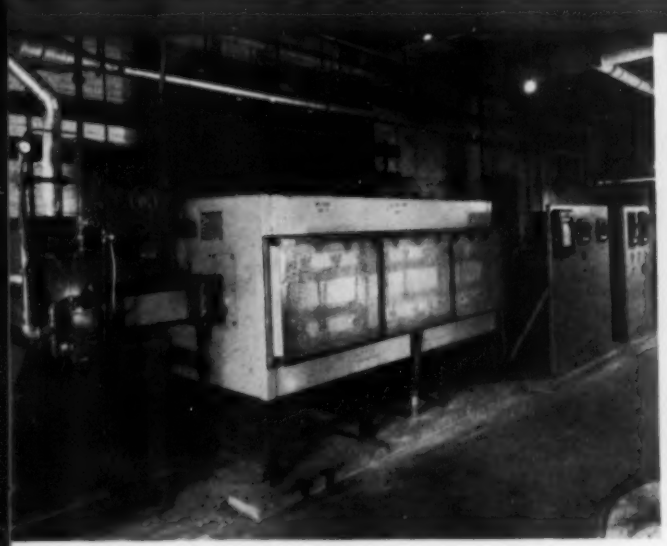
A new type test bar designed to divulge the cracking tendencies of steel on quenching has been developed by Chrysler metallurgists. Tests conducted up to the present time indicate that carbon content may be more important than hardenability in determining the susceptibility to cracking of certain quenched steel parts.

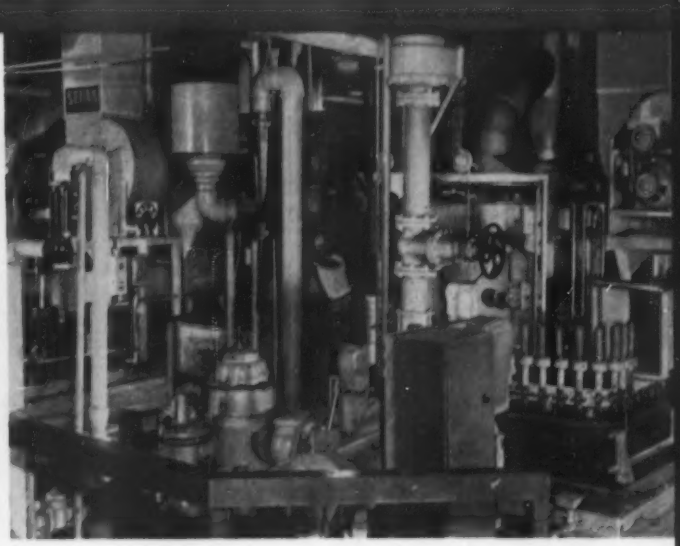
A significant recent development is a new carburizing steel containing approximately ½ pct Mo and ½ pct Mn, designed to produce high case hardness with minimum distortion on quenching. Several heats of the new steel have already been used with considerable success. The new steel has excellent machining characteristics. No tendency to retain excessive amounts of austenite on quenching has been observed.

The potential advantages of controlled atmosphere heat treating include more uniform production, easy integration into in-line operations, elimination of unnecessary manual labor, elimination of waste disposal problems and reduced production cost. Cleaning problems, particularly those associated with oddly shaped parts and inaccessible areas, are eliminated. Abrasive blasting and pickling may often be avoided. Carbon content can be adjusted to the desired level.

As the principles of heat treatment have become better understood, the use of cycle annealing has increased. Similarly, better understanding of desirable structures from the standpoint of machining have increased the need for tighter control during annealing operations.

The development of large, continuous, zone-type annealing furnaces capable of restoring carbon to decarburized hot-rolled steel by means





of improved automatically controlled atmospheres has given the heat treater the tools necessary to achieve more uniformly satisfactory results, often with a saving in time.

Within the past 5 years, the use of cyaniding for heat treating has been reduced in many large industrial plants. For many applications, cyaniding has been replaced by carbo-nitriding operations which are somewhat less hazardous from an operating standpoint. Also, the increasingly troublesome problem of cyanide disposal is eliminated.

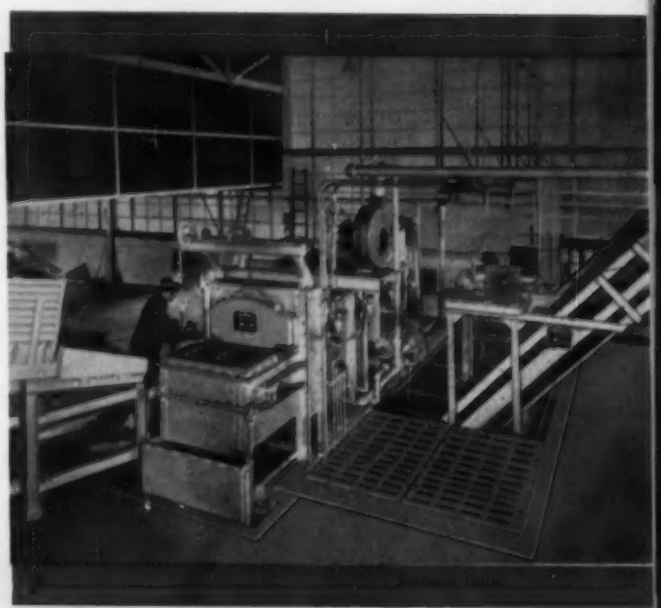
There has been a noticeable increase in the use by metallurgists of end quenched bars that have been drawn at various temperatures. This has permitted more intelligent selection of the right steel for the job.

The major technological advances made during the past few years by the malleable iron industry include: (1) Better control of melting, (2) Improved control of annealing operations.

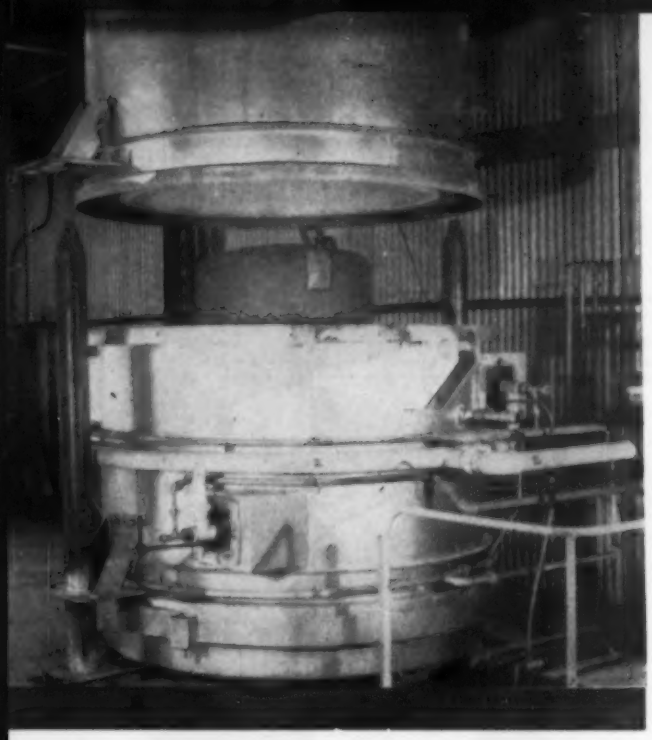
Malleable iron plants are stressing better control of operations. The use of boron has increased but more plants are using boron in amounts that appear to be relatively small—from 0.0008 pct to 0.002 pct. Annealing times have been shortened by as much as 25 pct using improved foundry practices.

Short time cycles, accurate control and good reproduceability make induction heating well suited to automatic handling. Using the latest automatic materials handling devices, many induction heating applications can be made fully automatic.

An excellent recent example of induction hardening involves automobile axles that are being hardened six at a time to rigid specifications. The versatility of induction heating is illustrated by the fact that these same axles are selectively annealed during the same cycle for subsequent







6 TOOL STEEL bars of wide analysis range are annealed uniformly in this bell-type furnace.

7 U-SHAPED harden-quench-draw line at Inter-State Drop Forge meets all needs for flexibility.

8 DIRECT, gas fired, special atmosphere forced circulation furnace handles wire, rod, strip.

9 HARDENING specifications on "prop" shafts are held accurately in this furnace at Taft-Peirce.

10 STAINLESS parts acquire a bright finish in this full-muffle hydrogen atmosphere furnace.

machining of the keyways in the axle shafts.

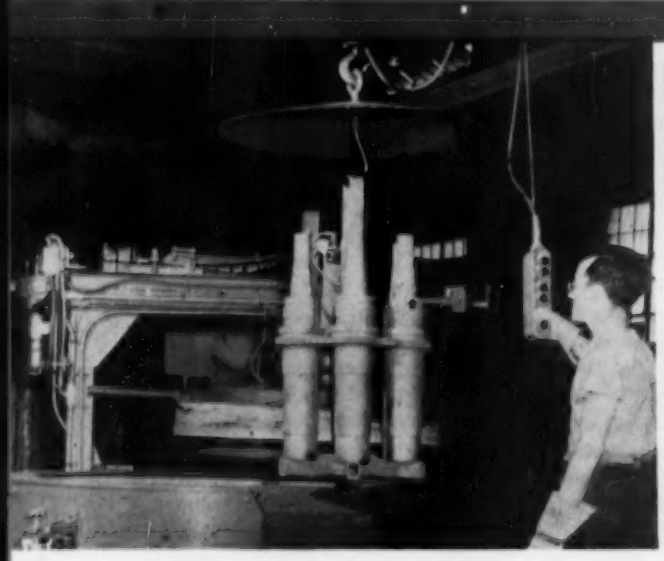
Selective hardening of camshafts, forgings of ferrous and nonferrous parts, brazing of carbide tips and sizing of new axle housings are only a few of the applications where induction heating and automatic handling have teamed up for high production. Where the economics are satisfactory, fast, clean selective induction heating may often be used to excellent advantage.

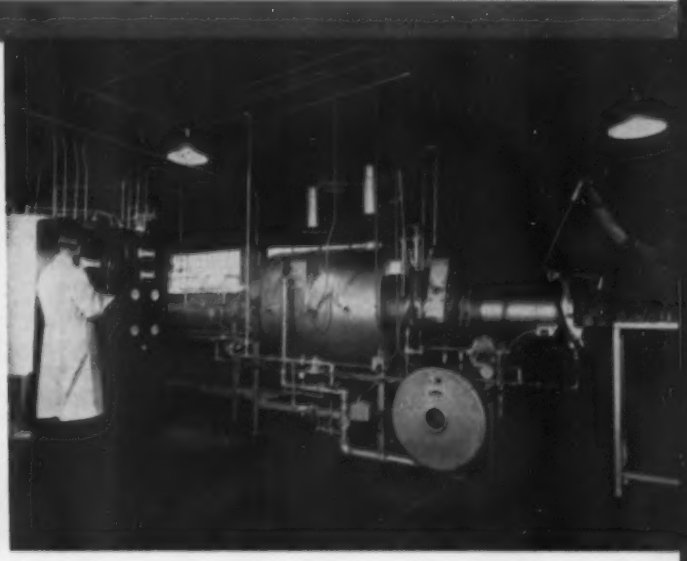
Automatic handling in many forms has been used in the heat treat department of modern plants wherever such methods are justified by the size and shape of the part and the volume. Continuous furnaces for annealing and hardening have been in use for many years. Continuous tempering furnaces have also become increasingly popular.

Selective heating increases output

Selective hardening using electricity or gas has created many opportunities for automatic handling of materials and this has been done in many plants to excellent advantage. Selective hardening of camshafts using either gas or electricity is an example of volume production heat treatment combined with fully or semi-automatic handling. Induction heating has also been combined successfully with machining operations, including automatics. The savings in time, manual handling and floor space, and improved quality of the work readily justify the initial cost.

Automatic heating for forging has been adopted at a spectacular rate. Fast, through heating with gas, and selective heating using electricity or gas have made remarkable gains in the forging industry. Combined with multi-station forging operations, substantial economic advantages are possible using automatic selective heating.





HEAT TREATING

the future

PRECISION to a degree merely dreamed of today will characterize heat treating of the future. The vast research knowledge of the present, linked with the many new tools for both research and control, will find wide application in heat treating operations of tomorrow. The high precision which they will make possible will be reflected in better parts, equipment, and methods.

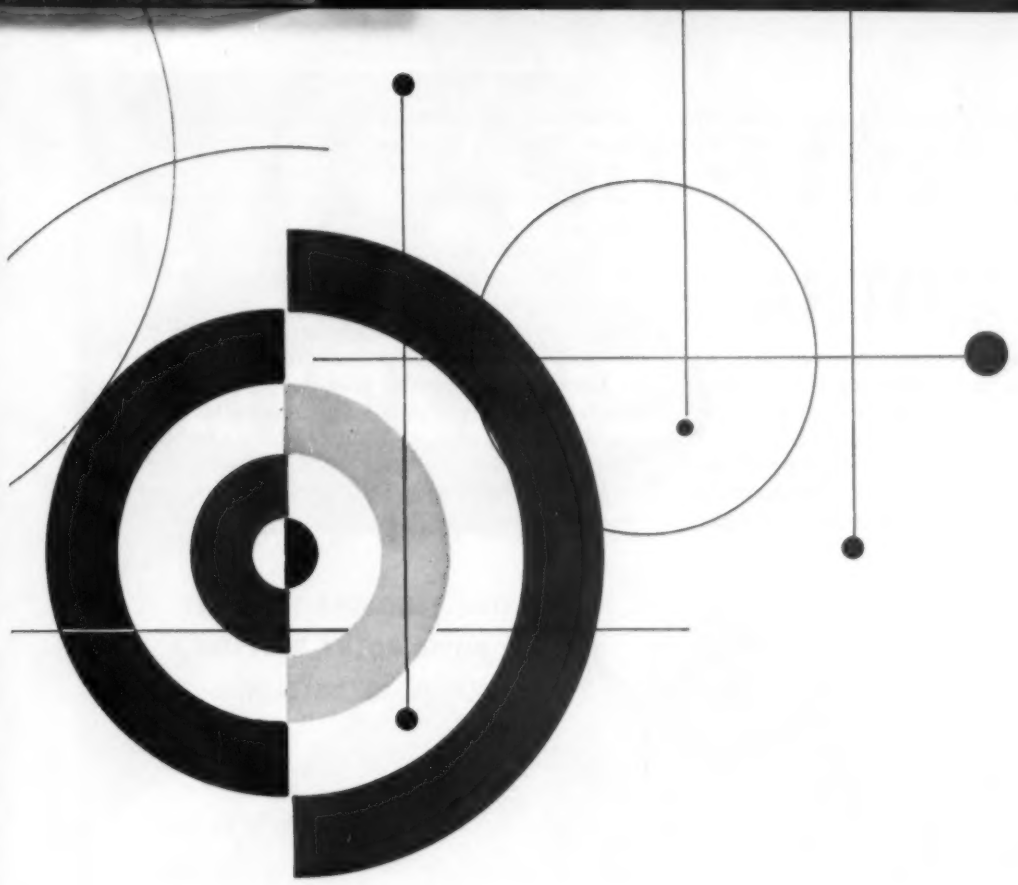
The need for precision is evident in the increasingly rigid quality requirements of the metalworking industries. The strong emphasis on "control" is characteristic of industry's present needs, its attempts to attain them, and the goals it has set for the future.

Control of distortion and warpage while attaining heat treated properties superior to those known today will be one of the achievements of the future. The need for such control, to eliminate secondary machining or other operations, has long been apparent.

Much effort to control distortion has involved quenching systems, special work holding fixtures, more uniform temperatures. Die quenching and roll quenching have been used. These measures largely compensate for distortion, often result in overcompensation. Design of quenching dies that take into account allowable machining tolerances is often difficult.

The future will see increased use of martempering and austempering for the control of distortion. These treatments are already being used on a production basis with considerable success. Gears can be quenched to such accuracy that grinding or lapping operations after heat treatments are not necessary. Mechanization of martempering and austempering setups will continue to occupy the attention of production experts desiring both high production and close control in heat treating.

Metallurgists of the future will be able to achieve far superior results through improved understanding of stresses. Increased knowledge of internal stress patterns in dynamically



loaded parts such as gears will permit improved design and heat treatment. This will result in a lower incidence of fatigue failure and possibly a saving in weight.

In the not too distant future design engineers and metallurgists will be able to take advantage of stresses trapped in the part by processing operations rather than being at their mercy as they virtually are today. Further, the future will see increased understanding of the interrelation of steel selection, part design and heat treatment. In the years ahead both designers and metallurgists will undoubtedly place greater reliance on stress calculations.

While not a substitute for the laboratory or field test, stress analysis, aided by the new mechanical brains and other research tools, looks like a good bet for the future.

Increased use of closely controlled furnace atmospheres can be safely predicted. The use of closely controlled furnace atmospheres touches major cost factors in so many ways—dimensional control, surface condition, cleaning, handling and uniformity. Increased use of newer and better atmosphere control equipment is assured.

Further study of annealing cycles as a method of eliminating handling, lowering machining costs and insuring better surface finish can be predicted with certainty.

The large number of carbo-nitriding furnaces sold during the past few years is a reflection of the trend toward carbo-nitriding to replace cyaniding equipment. As fast as new capital becomes available, many companies plan to make this change.

Future studies of quenched and drawn steels and their microstructures and physical properties will permit the compilation of data correlating the structure, hardness, etc. of steel at specified hardness levels. Ability to correlate hardness and structure at the various carbon levels will be an important forward step for the metallurgist.

Quality control of heat treated parts is advancing rapidly and is being extensively applied. Increasing use is being made by metallurgists of the new tools developed by the mathematicians to study products in production.

The introduction of automatic gaging has undoubtedly tightened the requirements facing many plant metallurgists. New, more sensitive carbon level indicators will permit better control of carburizing operations.

Many heat treating operations today are

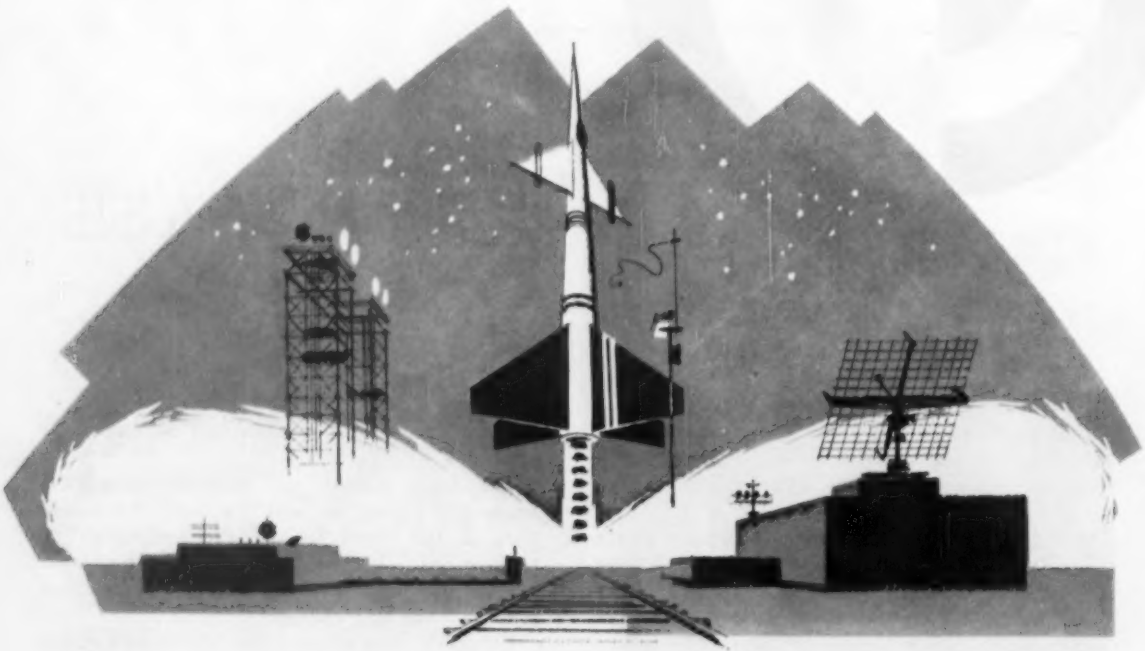
highly mechanized. But the standout trend now well established—is the incorporation of heat treating operations as integral portions of individual machines and production lines. In many large plants the isolated heat treating department to which work must be carried may be eliminated. The in-line heat treating of the future will accomplish the task with little or no handling.

Even though tremendous progress has already been made in mechanizing heat treating operations, strong trend factors will compel continued application of automatic processing. The growing necessity for eliminating unnecessary machining is one reason. The need for holding distortion to a minimum is another.

throughout the cross-section, an equal or better product quality than was obtained with alloyed steels. As a result there is a trend toward the use of lower alloy or even plain carbon steels in many cases.

Furnace makers in recent years have made great strides in the building of more flexible, more rugged, and safer equipment. Engineering ingenuity will, however, be constantly tested by the heat treating requirements of the future.

Furnace equipment of the future, designed to operate in closely integrated automatic processing setups, and in many cases at considerably higher temperatures, will meet new standards of safety. Furnaces will also have improved seals for greater efficiency.



The increasingly rigid quality requirements of secondary metalworking industries and rising costs are other factors creating a demand for more automatic equipment.

Induction and flame hardening equipment are ideally suited to use in the production line. They lend themselves well to automation and can often be incorporated into machining operation with obvious advantages. Since the equipment remains relatively cool it is easy to tool for mechanical operations. Sixty cycle equipment will be used in many more applications in the future.

The use of induction and flame hardening has affected the selection of materials in some cases. Often it is possible to achieve in a low alloy steel, induction or flame hardened

MORE FAMILIAR tomorrow than today will be the guided missile blasting into the skies beyond the range of eye and ear. Metals more precise in their content and structure than any known today will be needed to extend the usefulness of the missile beyond the weapons stage. At the enormous speeds of missile flight, air friction heats the outer skin to temperatures beyond the working limits of most present day metals. The development of metals capable of sustained strength under high temperature operation offer the metallurgists of today and tomorrow a tremendous challenge.

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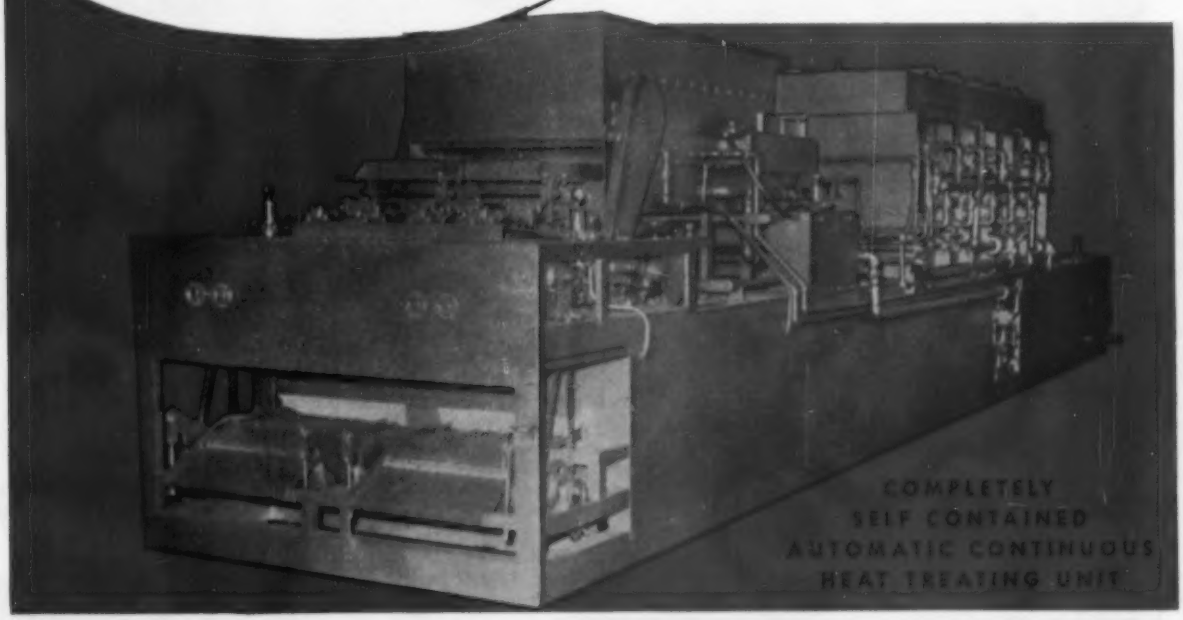
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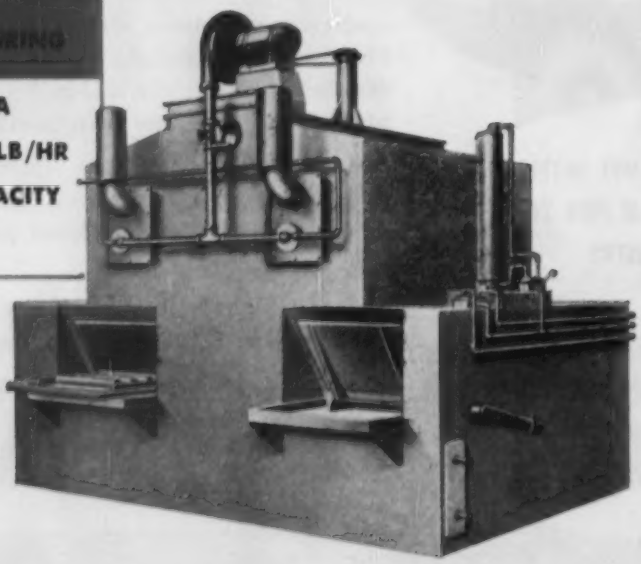
BATCH FURNACE

FEATURING

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500 LB/HR

CAPACITY



Holcroft's new bantam-sized batch furnace for controlled atmosphere heat treating does a king-sized job at a low, low cost. An entirely new concept of batch operation, the furnace offers new opportunities not only for small plants, but for large ones which have limited or varied production problems. The new batch furnace offers the same engineering know how and quality that has made Holcroft the leader in heat treat development.

It can be adapted to run such typical cycles as: carburizing; carbonitriding; clean, neutral and bright hardening; carbon restoration; normalizing; annealing; tempering and non-ferrous heat treating.

Operation is simple—only two valves are involved. When the stock has completed its time in the furnace chamber it is lowered by an elevator, transferred into position for quenching, and lowered into the quench oil. Simultaneously, a previously-loaded tray of cold work moves onto the charge elevator and then up into the furnace chamber. The operator may remove the quenched stock from the discharge door or load the furnace through the charge door at any time during the heating cycle.

Quenching is fast and there is no loss of heating time loading or unloading. This arrangement reduces atmosphere gas requirements because vestibule flushing takes place while the stock is being heated.

An important feature of the new furnace is its small floor space requirement. No pits are needed; the heat source is above the vestibule—improving working conditions.

HOLCROFT & COMPANY, 6545 Epworth Blvd. Detroit 10, Mich.

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3. **Tray size**—two 24" x 18" pinned sections with basket on each section for loading 9" high.
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5. **Quench tank**—completely enclosed with built-in cooling. Hot oil optional.
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Quotes: 1855 — 1955

Abstracts from past issues of THE IRON AGE, *selected for their flavor, and with some regard for whimsy:*

Use Natural Gas to Anneal Sheet

At a recent meeting of a local engineers' society at Pittsburgh, William Metcalf read a very instructive paper on natural gas.

No Scale Problem

"I will mention another application of this gas that I heard of the other day. I did not include it in my paper because I had no opportunity of seeing it for myself. It is certainly very peculiar, and if it is anything like what is reported it is another adaptation of the gas. It is in pickling, or rather doing away with pickling. All who are familiar with the manufacture of very thin sheets of metal, either iron or steel, know the great difficulty there is in pickling the scale off, in order to get a fine finished surface. They know the danger of the acid penetrating through the metal and destroying it. It is a difficult thing to do well, and the operation is one that must be done carefully, and is one that everybody that has it to do will be glad to get rid of. I am told that a gentleman at Leechburg, now applying for a patent on the process in annealing fine sheets, brings the annealing-box to the required heat by use of the natural gas, and then, by a pipe connected into the box, when the metal is hot enough, turns in a stream of the natural gas on to the material, and allows it to pass through, keeping the box hot for some little time, and then allowing it to cool gradually, when the whole mass of sheets come out perfectly clean, as clean as tin, but not as bright, but entirely

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clean; and, singular to say, though the sheets are very thin and packed closely in heavy boxes, this gas in some way gets in all among them, and they come out perfectly clean and free from scale. This is another application of the gas that will certainly be of great benefit if it proves to be practicable, and there is no reason why it should not be."

Jan. 1, 1885

Die Quenching

We take from the records of the patent office at Washington the following specifications of certain patents lately issued, which will be found interesting:

Specification forming part of Letters Patent No. 134,264, dated December 24, 1872, issued to James A. Fersen, of Fitchburgh, Mass.

In the manufacture of spring wire horse rake teeth the teeth are sometimes hardened to shape by bending them upon a former, and, while held in bent position, immersing them in the hardening liquid contained in the hardening vat. When removed from the vat and from the bending mechanism or former, they are afterward heated and tempered; but, notwithstanding the hardening, when bent they sometimes fail to perfectly retain their bent shape, from want of uniformity of metal or from failure to become uniformly hardened, or from some other cause.

In Perfect Shape

To remedy this difficulty each tooth is taken as it comes from the hardening vat, and preferably before it gets entirely cold, and placed in a holder that confines it positively in perfect shape, and then, while so held and confined, heated and tempered while upon the former, preferably using a former that will receive a series of teeth for each operation. It is in this process of tempering horse rake teeth while held to their ulti-

Shuts Doors, Windows, Stops Conveyors
Sounds Alarm...

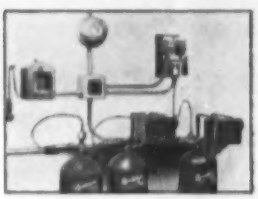
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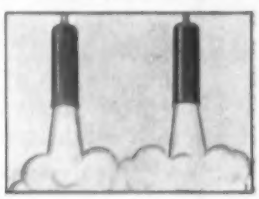
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For a summary of THERMAL Products & Services, write for Bulletin #108

OTHER THERMAL PRODUCTS & SERVICES

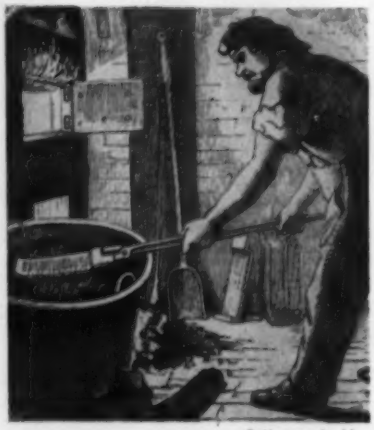
GAS, OIL & COMBINATION GAS-OIL BURNERS
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Bettman Archive

QUENCHING pins from wood fired furnace during 19th century.

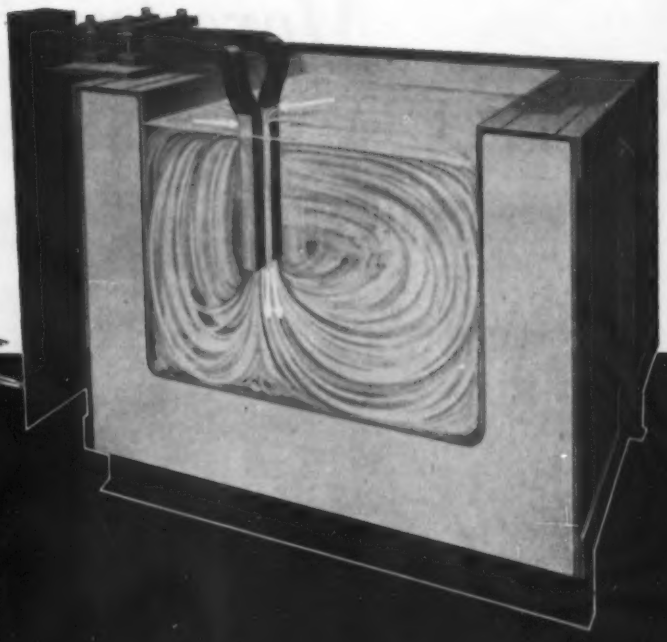
mate form that my invention consists.

The holder consists of a curved steel bar, with steel pins extending therefrom, one pin being of a size to receive the eye of the rake tooth, and the other arranged in a series and in such relative positions, and at such distance apart, that when the wire is run through them, passing in front of one and back of the next, and so on through the series, it will have the curved form ultimately to be possessed by it. The pins are made sufficiently long to receive several teeth, each passing between the teeth. When the hardening process has reached the proper stage the formed teeth are removed from the hardening vat, and then, instead of being tempered without restraint as to form, each is bent to its proper shape between the pins, or by means of any other suitable holder that will confine the wire in shape, and the holder is then, with the tooth or teeth so confined or held by it, introduced into the tempering furnace, so that the tooth will be tempered to shape or while held in shape. The tooth thus made retains its form, so that in any departure therefrom by springing it invariably recovers its normal shape when released from strain.

Much More Perfect

In practice it is preferable to heat to temper before the teeth become wholly cold after harden-

Suspended-electrode type furnace

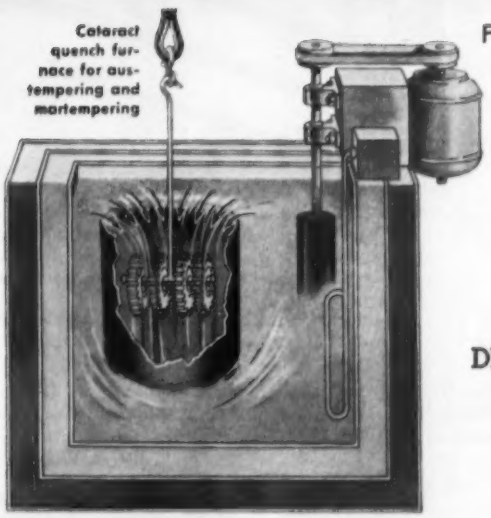




AJAX
HULTGREN

Salt Bath Furnaces

Cataract quench furnace for austempering and martempering



For any of these applications . . .

ALUMINIZING
ANNEALING
AUSTEMPERING
BRAZING
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DESCALING . . . DESANDING
DRAWING
HARDENING
HEATING FOR
FORGING AND FORMING
MARTEMPERING
SOLUTION HEAT TREATING



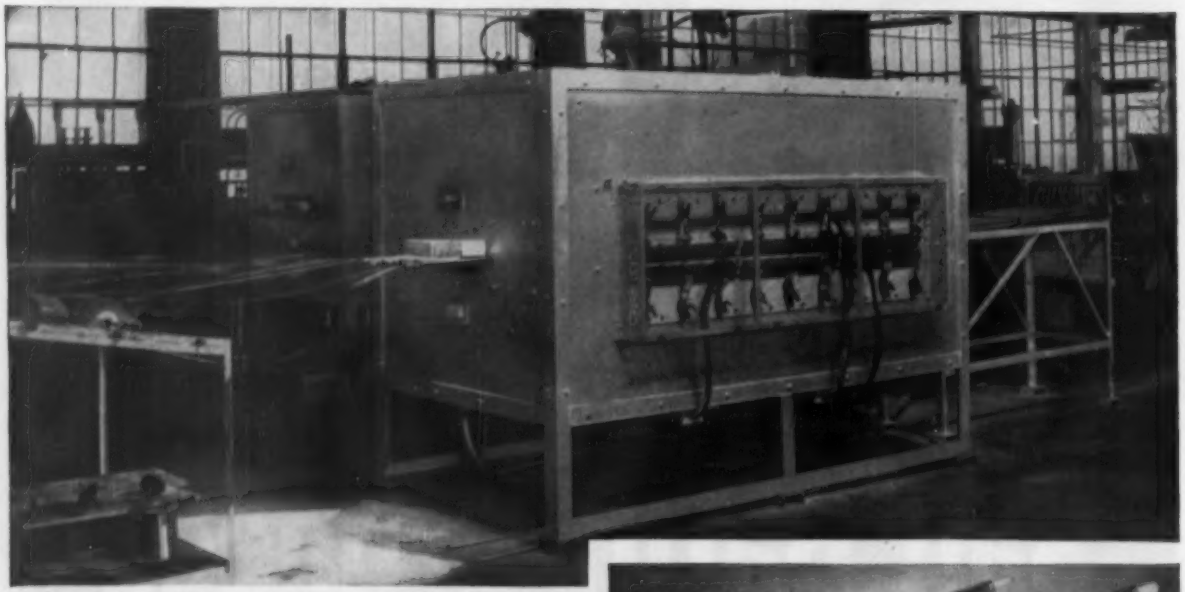
FREE! SALT BATH HEATING TIME CALCULATOR FOR STEEL. Handy slide chart. Write on company stationery.

Write for Details including actual case history data for any job.

AJAX ELECTRIC COMPANY 904 FRANKFORD AVE. **Philadelphia 23, Pa.**

Associated Companies: Ajax Electric Furnace Corp. • Ajax Electrothermic Corp. • Ajax Engineering Corp.

More proof that "HOT RODS" last 3 times longer



Completely Equipped With "Hot Rods" after Norton CRYSTOLON heating elements proved their ability to outlast others 3 to 1. This electric furnace is one of a battery operated by the Alloy Metal Wire Division of H. K. Porter Company, Inc. of Prospect Park, Pa., for bright annealing alloy wire at 2150F. Heating elements operate in an air atmosphere, while the wire passes through tubes containing a controlled split-ammonia atmosphere. These furnaces idle at 1700F-1750F on weekends and holidays, so element service is continuous.



Norton CRYSTOLON Heating Elements, or "Hot Rods", are a typical Norton ℞ — an expertly engineered refractory prescription for greater efficiency and economy in electric kiln and furnace operation. Made of self-bonded silicon carbide, each rod has a central hot zone and cold ends. Aluminum-sprayed tips and metal-impregnated ends minimize resistance and power loss. Available in standard sizes.

Alloy Metal Wire Division H. K. Porter Company, Inc. converts to CRYSTOLON heating elements after tests prove superiority of latest Norton ℞*

Like many another new user of "Hot Rods" the Alloy Metal Wire Division of H. K. Porter Company, Inc. found that these Norton CRYSTOLON heating elements last much longer. Here is a summary of the tests responsible for this company's decision to make a complete change-over to "Hot Rods."

Electric furnaces at the company's Prospect Park plant are used for bright annealing alloy wire at 2150F. Previous heating elements had given approximately 4 to 6 months service with 3,048 hours as the best recorded service life. Then, in a furnace completely equipped with "Hot Rods" the Norton elements averaged 18 months of continuous service — or over 13,000 hours per element. Once again "Hot Rods" proved their ability to outlast competitive elements — by better than 3 to 1!

But that's not the whole economy-story. The much longer life of "Hot Rods" also means savings in element costs, because fewer "Hot Rods" are needed — *plus* reduced maintenance, due to less frequent changing — *plus* fewer changes in voltage taps — *plus* a smoother production flow.

Put these advantages to work for YOU

in your own electric furnaces or kilns. The big illustrated booklet, *Norton Heating Elements*, gives complete details on how this proved Norton ℞ cuts operating and maintenance costs. For your copy, write to NORTON COMPANY, 205 New Bond Street, Worcester 6, Mass.

NORTON

REFRACTORIES

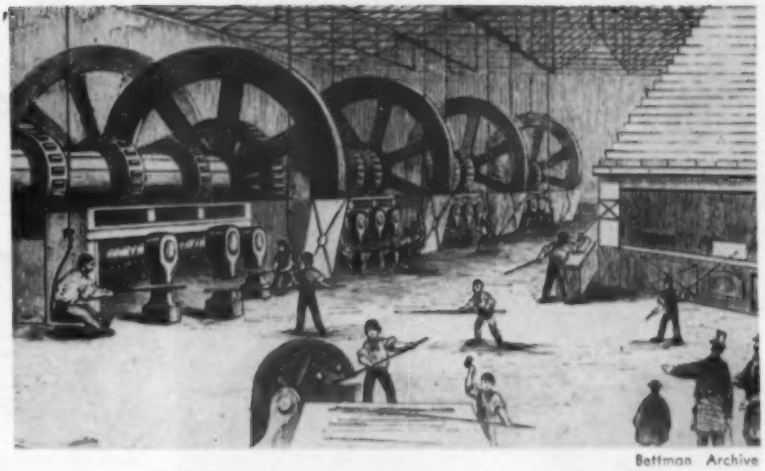
Engineered... ℞ ...Prescribed

Making better products... to make your products better

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

ing. Teeth thus made are not only much more perfect as to form or permanency of form, but are far less liable to break. The teeth may be hardened to form otherwise than by the specific process described, although that is considered the best method; but in every case the teeth are first hardened to form and are subsequently tempered upon a former.

Feb. 13, 1873



Bettman Archive

HEATING FURNACES were crude affairs in the mid 19th century when this woodcut of an "iron bar forgery" was made. Note hanging seats.

Smoke Control

An organization known as the Ladies' Association of Cincinnati have sent to the Board of City Commissioners the following pathetic memorial:

"To the Board of City Commissioners: The association of ladies for the promotion of the cleanliness of the city beg leave to again call the attention of your board to the subject of smoke consumption at the City Water Works.

"Thoroughly Practical"

"Since we had submitted our views to your board the Jury Reports of the Cincinnati Exposition have been published, and it has been thus publicly made known that there are at least five or six methods of consuming the smoke in steam furnaces which are thoroughly practical and economical. Some of these can be adapted to ordinary steam boilers at so trifling an expense that there can be no reasonable obstacle to their general use.

"The possibility of rescuing our city from the reproach of being one of the dirtiest of the world has, therefore, passed from this condition of doubt or of experiment to that of complete and proven feasibility. What is needed is that this should be brought to the attention of private manufacturing establishments by prominent public examples in successful operation.

"It has been proven that a large economy in fuel may be made, besides saving the city from the defilement of great clouds of soot, if your board will direct one of the several successful smoke consuming devices to be applied to the furnaces of the water works under your control.

"We therefore again appeal to you to comply with the general wish of the citizens of Cincinnati, and set the example of a hearty effort for a reform which alone would make the city one of the most attractive on the continent.

"We hand herewith a copy of the report of the jurors and committee of the Exposition showing the complete success, economy and business advantages of the several devices passed upon by them."

We fear that the dear ladies have availed themselves of their right to "jump at conclusions" in this matter. Probably they will never learn that to consume smoke

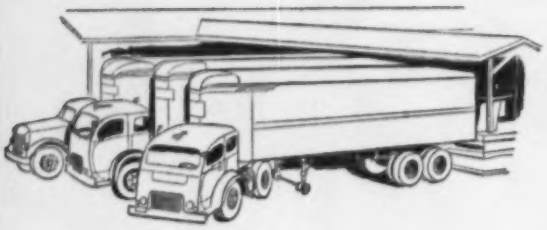


Bettman Archive

NINETEENTH CENTURY boiler plate "manufactory" at Reading, Pa.



Roy Fruehauf, President, Fruehauf Trailer Company



"Business Publications Are Vitally Important To Me..."

says Mr. Fruehauf. "Frequently I find facts and ideas in business publications that help me to make important decisions. We know our customers and prospective customers read *their* business magazines, too. We carry substantial advertising schedules in several different groups of business periodicals."

It is good thinking to judge an advertising medium by the value its editorial pages deliver to regular readers. Business publications provide a direct sales route for any product or service of benefit to business or professional men.

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The national association of publishers of 171 technical, professional, scientific, industrial, merchandising and marketing magazines, having a combined circulation of 4,049,550... audited by either the Audit Bureau of Circulations or Business Publications Audit of Circulation, Inc.... serving and promoting the Business Press of America... bringing thousands of pages of specialized know-how and advertising to the men who make decisions in the businesses, industries, sciences and professions... pin-pointing your audience in the market of your choice. Write for list of NBP publications and the latest "Here's How" booklet, "How Well Will We Have to Sell Tomorrow?" by Ralston B. Reid, Advertising & Sales Promotion Manager, Apparatus Sales Division, General Electric Company, Schenectady, N.Y.



7 WAYS to SAVE MONEY with TOCCO* Induction Hardening



Cost was reduced 94% when heat-treatment of this corn-harvester part was changed from carburizing to TOCCO-hardening, 9½c saved on every piece — $4750 on each 50,000 piece batch, plus an hourly production increase from 120 to 300 pieces per hour.



$375 per day! When Salisbury Axle switched to TOCCO-hardening axle shafts. Less machining—30 seconds instead of 2 minutes—means lower tool cost. Also production zoomed from 50 to 120 per hour. TOCCO hardened shafts have 200% greater torsional life.



Kearney & Trecker Corp. reduced the cost of hardening this milling machine part from $1.57 to 10c apiece. In addition TOCCO made possible a switch from alloy to S.A.E. 1045 steel—saving another 11c per piece in material cost. Kearney & Trecker hardens 140 different parts on one TOCCO unit.



Thompson Products Ltd. boosted production of these automotive wrist pins from 500 to 1200 per hour when they switched to TOCCO-hardening. Costs fell from $5.45 to $3.25 per hundred parts—a savings of 2c per pin, $26.40 per production hour.



Mechanics Universal Joint Division of Borg-Warner reports a 69% savings in the hardening of stub ends for propeller shafts. TOCCO also upped production from 35 to 112 parts per hour—over three times as fast as conventional heating methods.

Lima-Hamilton Corporation adopted TOCCO for hardening this shifting lever. Results: a savings of 4c per piece—$25 per production hour. TOCCO costs only 17% of former heating method. This is only 1 of 139 parts TOCCO-hardened by Lima-Hamilton Corp. All show savings over usual heating methods.



7 Number 7—the lucky number—is up to you. Why not add your name to the list of companies who use TOCCO Induction Heating to increase production, improve products and lower costs. TOCCO engineers are ready to survey your plant for similar cost-saving results—without obligation, of course.

THE OHIO CRANKSHAFT COMPANY



Mail Coupon Today

NEW FREE BULLETIN

THE OHIO CRANKSHAFT CO.
Dept. A-6, Cleveland 1, Ohio

Please send copy of "Typical Results of TOCCO Induction Hardening and Heat Treating."

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Company_____

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City_____ Zone____ State____

is practically an impossibility. The solution of the problem depends wholly upon the completeness of the combustion, which is not easily secured with a durable construction for soft coal. This is a many-sided problem, and its solution will never be reached by the simple expedient of "be it enacted" or "resolved."

Feb. 19, 1880

Ball Game Scheduled

The employees of the Hart Manufacturing Company and Russell & Erwin Mfg. Company will play a matched game of baseball on Saturday next at four p. m. on the Champion Baseball Club grounds, Grove Street near Railroad Avenue, Jersey City.

June 15, 1871



Bettman Archive

TEMPERING SPRINGS. Woodcut, 1873. Note quenching setup.

Merrily, We Roll Along

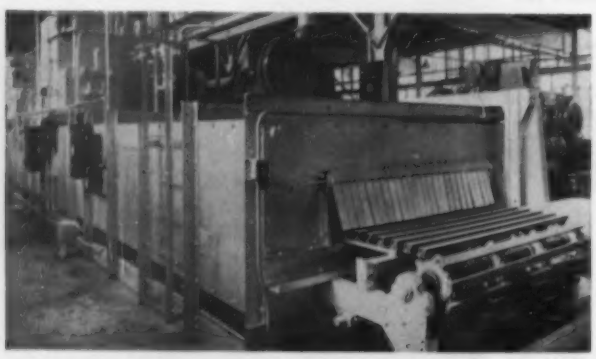
The Pall Mall Gazette says that the velocipede is becoming a formidable rival to the horse in Paris. One velocipedist rode down the Champs Elysées the other day in an "Americane" drawn by two velocipedes on which were mounted two postilions or jockeys. The velicipedal skill of M. de Visin is said to be something extraordinary. A few weeks ago he undertook to travel on a velocipede from Angers to Paris, and actually went as far as Tours, a distance of about fifty-four miles, when the machine broke.

June 1868

Two Locomotives Built

Two locomotives have been built at Mason & Co's. Works, Taunton, Mass., for the railroad on the Isthmus of Suez, Egypt.

June 18, 1856



"CIRC-AIR" FURNACES
HOLD TEMPERATURE AND TIME CLOSER THAN ANY OTHER HEATING MACHINE

"Circ-Air" Furnaces heat Steel, Aluminum, Cast Iron and Brass up to 1450 Degrees F.

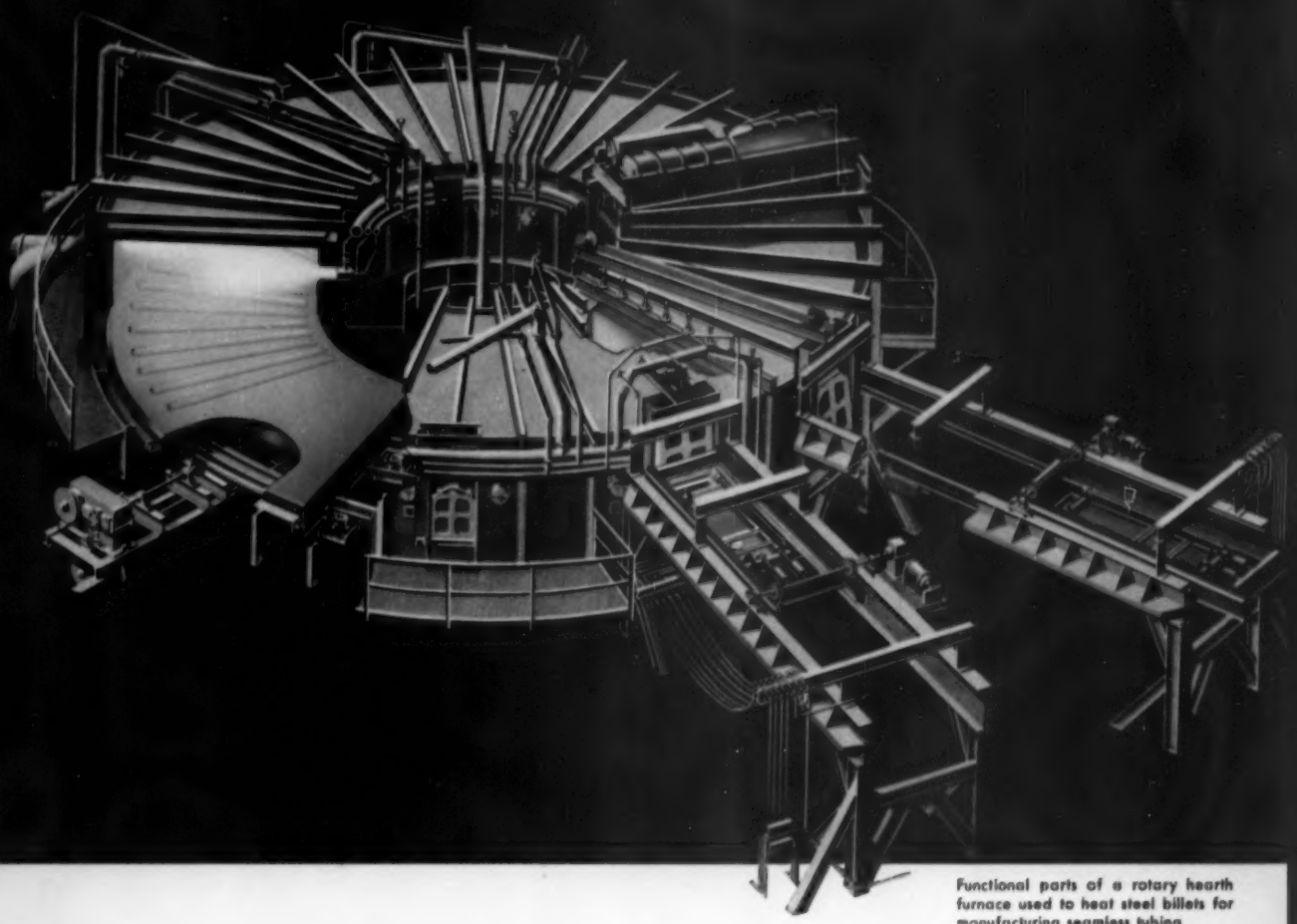
"Circ-Air" Furnaces are designed and built to the customers requirements for Drawing, Solution Treatment, Brazing, Stress Relieving, Isothermal Treatment, Bluing, Annealing, Ageing and Forging.

Write for Bulletin 13-A

CIRC-AIR **INDUSTRIAL HEATING EQUIPMENT CO.**
3570 FREMONT PLACE
DETROIT — 7 — MICHIGAN

ACKNOWLEDGMENT

In addition to those mentioned in the text or in photo credits, the editors also want to thank the following for their help in preparing this section:
W. H. Holcroft, Executive Vice President, Holcroft & Co.; W. D. Latiano, Ohio Metallurgical Service, Inc., American Ceramic Society, American Society for Metals, Porcelain Enamel Institute, American Wheelabrator & Equipment Corp., American Gas Furnace Co., Carborundum Co., Chrysler Corp., Dodge Div., Climax Molybdenum Co., Dow Furnace Co., Eaton Mfg. Co., Ferguson Equipment Corp., Ford Motor Corp., General Motors Corp.: Buick Motor Div., Cadillac Motor Car Div., Central Foundry Div., GM Research, Pontiac Motor Div.; Great Lakes Steel Corp., George J. Hagan Co., C. I. Hayes, Inc., Holcroft & Co. A. F. Holden Co., Kidd Drawn Steel Co., Park Chemical Co. Pittsburgh Steel Co., W. S. Rockwell Co., Strong, Carlisle & Hammond Co., Inc., Swindell-Dressler Corp., Timken-Detroit Axle Div., Rockwell Spring & Axle Co., Titanium Alloy Mfg. Div., National Lead Co., U. S. Steel Corp., Vanadium-Alloys Steel Co., Warner Gear Div., Borg-Warner Corp.



Functional parts of a rotary hearth furnace used to heat steel billets for manufacturing seamless tubing

It pays to rely on Salem-Brosius for heating or heat-treating furnaces

Shown above is a rotary hearth furnace for which Salem-Brosius has become well-known. This highly efficient, space-saving unit is in general use today for production heating and heat-treating of carbon and alloy steel bars, slabs, round and square billets, shell and forging stock; and similar products in non-ferrous metals such as copper and brass. Most large rotary hearth furnaces in the world have been designed and built by Salem-Brosius or its licensees.

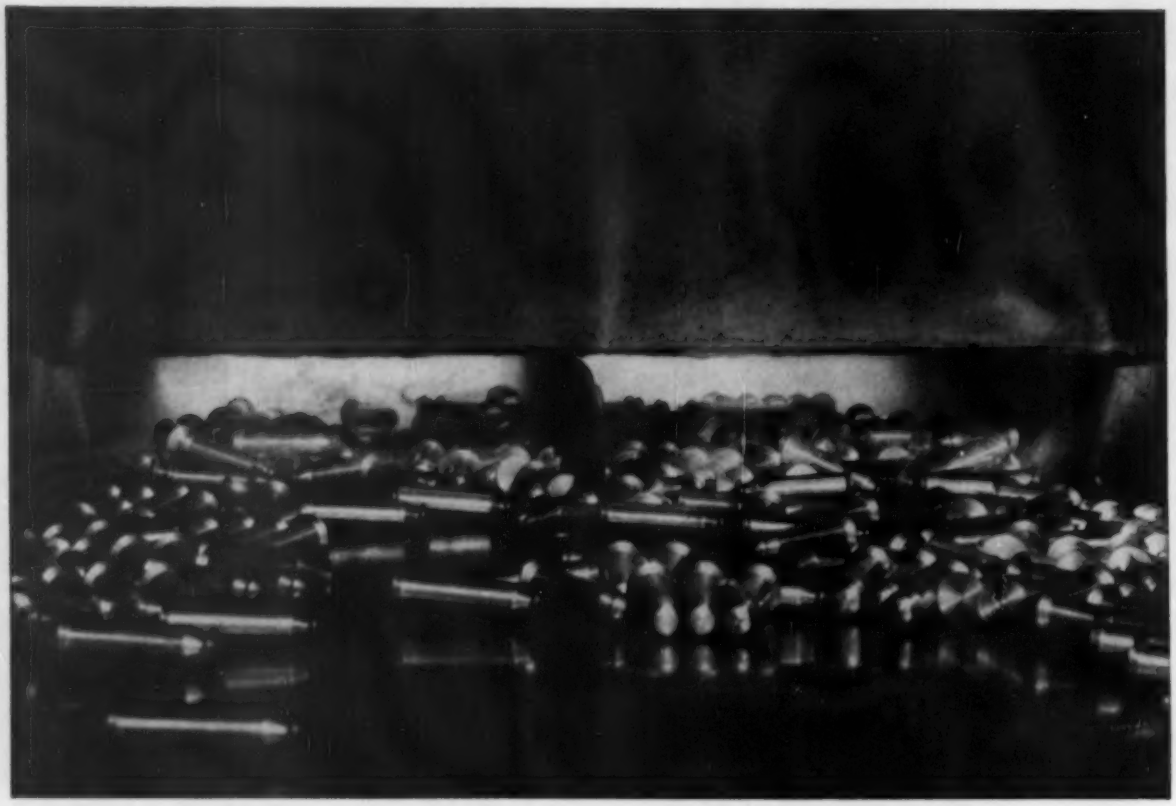
But this famous furnace is only one of the many successful types which the Salem-Brosius engineering staff has designed and constructed throughout the years. The list below will show you a wide variety which may be gas, oil, electric or radiant tube fired and may possess normal or special atmospheres. If you have any heating or heat-treating problems to solve, it will pay you to call on Salem-Brosius. Our engineers will gladly submit a recommendation.

- Soaking Pits
- Continuous Buttweld Furnaces
- Rotary Hearth Furnaces
- Pusher Type Furnaces
- Bell Type Furnaces
- Roller Hearth Furnaces
- Roller Rail Furnaces
- Slot and Other Batch Type Furnaces
- Car Type Furnaces
- Chain or Belt Conveyor Furnaces

SALEM-BROSIUS, INC.

CARNEGIE, PENNSYLVANIA

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No More Scaling Here.....
Despite Severe Oxidizing Conditions

A vibrating chute made of a HAYNES high-temperature alloy solved a tough maintenance problem in this heat-treating furnace. The chute spans the entrance to the furnace and is subjected to severe oxidizing conditions. Other chutes became loaded with heavy scale in a few months' time and had to be repaired or replaced. Now that the chute is made of a HAYNES high-temperature alloy, there is no more scale. Parts keep flowing along freely, rejections are way down, and maintenance has been practically eliminated.

There are 11 HAYNES high-temperature alloys. All have excellent strength at elevated temperatures, good creep and stress-rupture properties, and are extremely resistant to oxidizing or reducing atmospheres. One of them may be the answer to a production or maintenance problem in your plant.

For information on prices, sizes, and properties of these alloys, write to our general sales office in Kokomo, Indiana, or to any of the district sales offices listed below.

HAYNES TRADE-MARK ALLOYS

HAYNES STELLITE COMPANY

A Division of Union Carbide and Carbon Corporation

UCC

General Offices and Works, Kokomo, Indiana

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"Haynes" is a registered trade-mark of Union Carbide and Carbon Corporation.

The first Electric Brass Melting Furnace in America — built by The Electric Furnace Co., Salem, Ohio.





An EF combination electric and gas fired furnace installation in a prominent steel plant producing galvanized strip. This equipment flame cleans, uniformly anneals and galvanizes strip continuously.

EF

Continuing to pioneer

New Developments

in the continuous and batch processing of ferrous and non-ferrous products

From the company's beginning, when the little furnace shown above was "big news"; to the modern, completely automatic, high production strip lines, EF research and development engineers have been making important contributions to furnace design and metal processing techniques.

EF engineers conceived and developed the first automatic and continuous heat treating, quenching and drawing equipment; pioneered the use of endothermic, exothermic and other special atmosphere treatments resulting in closer physical tolerances.

Other developments include EF radiant tubes with heat exchangers that assure extremely high combustion efficiency; EF cast alloy electric heating elements; EF roller design—and other facilities that assure uniform temperatures throughout the furnaces, accurate control of heat input, reduced maintenance and high hourly output.

For maximum product uniformity, dependability and efficiency, discuss your heating problems with EF experienced engineers . . . it pays.

EF

THE ELECTRIC FURNACE CO.

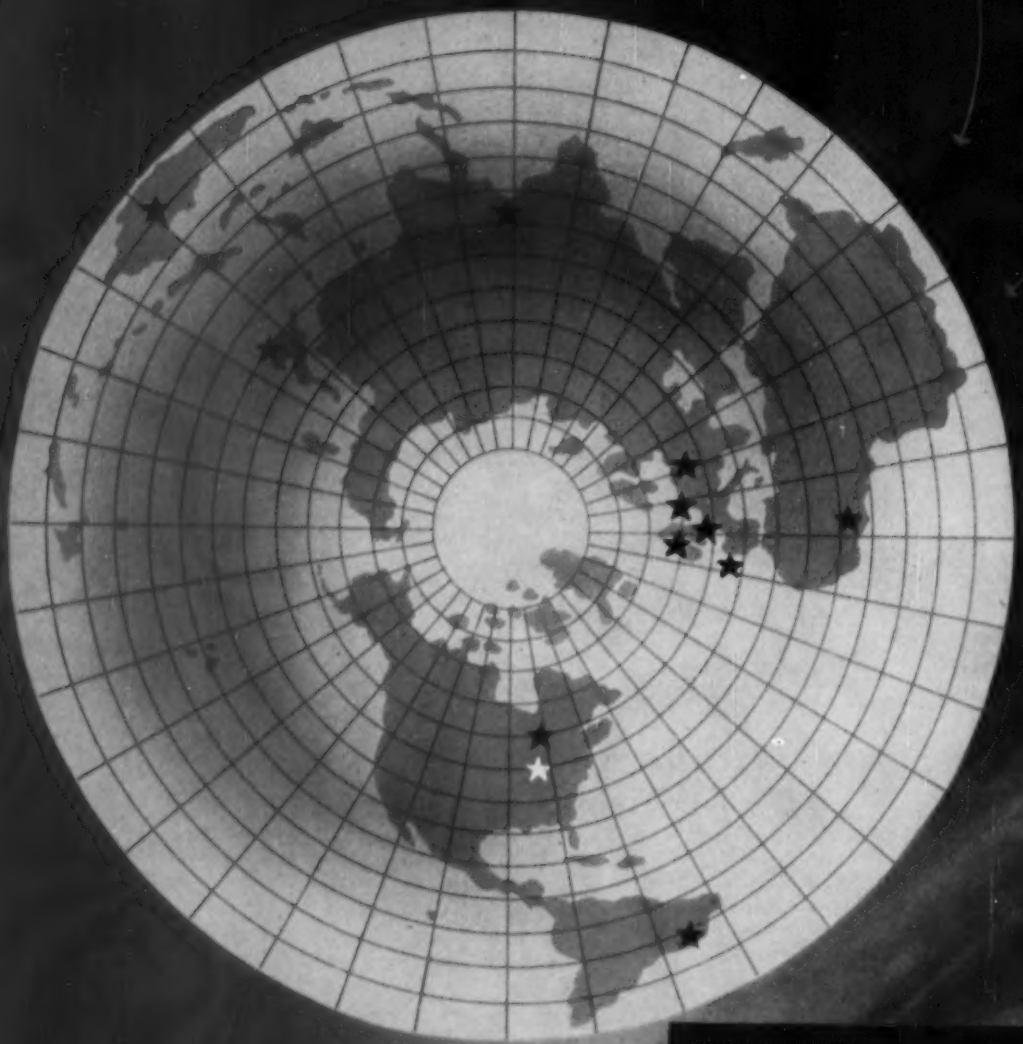
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- BRAZING
- ANNEALING
- HARDENING

QUOTES: 1855—1955

Continuous Casting

One single, simple process permitting a direct jump from molten metal to strip, sheet or billet is obviously reasonable. So reasonable, so apparently simple, that the past 100 years have brought forth a flood of schemes, innumerable variations of several basic ideas, most of which were doomed to burial in the patent office, a few of which actually experienced the trial by fire—and for the most part to be found wanting.

Today, quietly and for the most part secretly, there is a resurgence of activity. At Scovill Mfg. Co. a comparatively simple German unit is turning out 1,500,000 lb of extruding billets each week, week in and week out, without shutdown; Williams, at Latrobe, has an excellently designed mold which shows attractive possibilities with steel; Eldred's unit turns out beautiful metal and is being pointed, in part, toward scrap conversion in small plants; both the Aluminum Co. of America and American Smelting & Refining Co. have commercial outfits in daily operation; a Pittsburgh steel maker recently spent a small fortune on the Merle strip casting process; and Hazelett has devised a new high speed strip casting unit that will hit over 500 ft. per min. with non-ferrous metals and possibly with alloy steel.

April 4, 1940

Take the King PORTABLE to the work—not the work to the tester

USE THE KING PORTABLE
To Make Standard Brinell Tests

Puts an actual load of 3000 kg. on a 10 mm ball

The King PORTABLE BRINELL is guaranteed to make Brinell tests of the greatest accuracy on large and small parts of almost any shape. In addition, this versatile unit:

- can be carried anywhere to make tests or can be used as a bench tester
- can be used in any position—even upside down
- has a removable test head for testing parts of larger size

Ask for the folder illustrating and describing the many additional advantages.



ANDREW KING
Box 606 • Ardmore, Pa.



RICHARDS PYROMETER SUPPLIES

Control Temperatures More Closely
Reduce Cost—Save Time

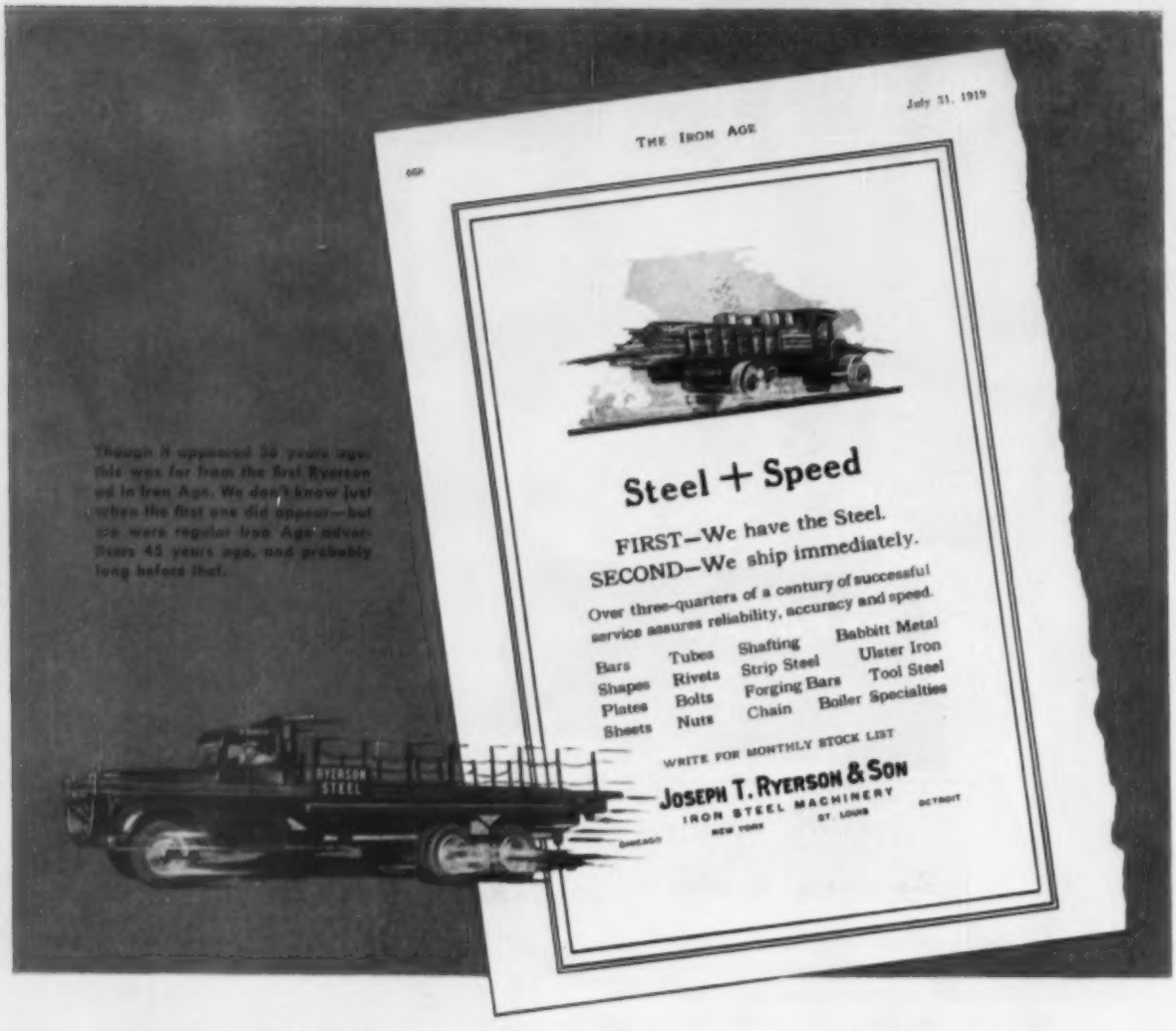
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Low prices for top quality—Prompt Shipment from stock

ARKLAY S. RICHARDS CO., INC.
Manufacturers and Engineers
62 Winchester Street NEWTON HIGHLANDS 61, MASS.

114 years of Ryerson steel service . . .



. . . now something new has been added!

The words haven't changed—Steel + Speed is still our story. But today we have given the words new meaning.

When we say "Steel" today we mean Ryerson Certified Steel—every pound protected by an exacting new quality control program. And we include many kinds of steel that were unknown or unavailable only a few years ago.

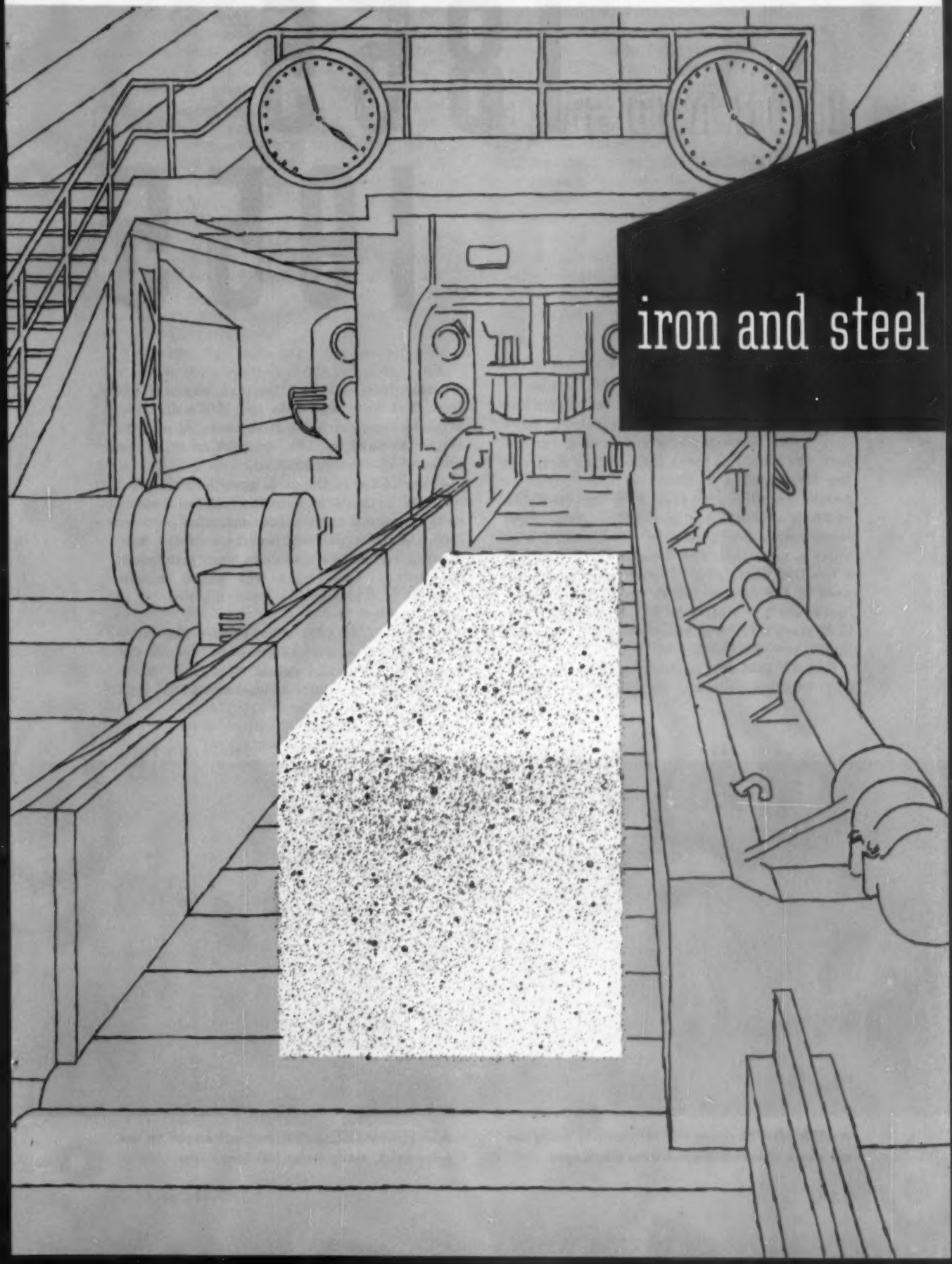
We have changed the meaning of speed, too. Today almost every order for steel from Ryerson stocks is shipped the same or the following day. And when emergency demands, we often ship in an hour or two.

Certified quality steel stocks, stainless steel stocks, leaded steel stocks—Ryerson was first with these important steel-service advances and continues to show the way. So when you want Steel at its best + Speed at its swiftest—call your Ryerson plant. **RYERSON STEEL**

In Stock: Bars, Structurals, Plates, Sheets, Tubes, Alloys, Stainless, Re-bars, etc.

JOSEPH T. RYERSON & SON, INC. PLANTS AT: NEW YORK • BOSTON • PHILADELPHIA • CHARLOTTE, N. C. • CINCINNATI • CLEVELAND DETROIT • PITTSBURGH • BUFFALO • CHICAGO • MILWAUKEE • ST. LOUIS • LOS ANGELES • SAN FRANCISCO • SPOKANE • SEATTLE

100 YEARS OF METALWORKING



iron and steel

IRON AND STEEL 1855 1955

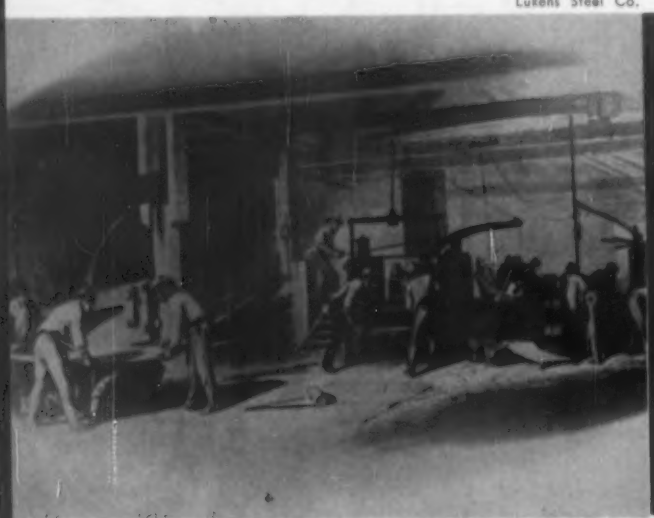
THE history of steel is the history of America. It provided the rails to develop the nation and tie it together, to fence the Western plains and develop agriculture, the trucks to move its food, the cans and the refrigeration to preserve it, to house its people, and the alloys to open the oil fields, equip its chemical and process industries. Steel consumption per person in the United States today is more than 1200 times what it was just a hundred years ago. Though iron was being used at the rate or 117 lb per capita in 1855, the figure for steel was but one pound. The U. S. made a tenth of the world's pig iron, less than 3 pct of its steel.

Back in 1855 the principal wrought product was iron; more than 98 pct of combined wrought iron and steel tonnage was wrought iron. Not until well into the 1880's did steel overtake wrought iron. It represented only 37 pct of the total in 1880, but grew to 91 pct by 1907 and 98.8 pct by 1929.

A key factor in the early growth of the steel industry in the U. S. were the railroads, which went through a tremendous expansion between 1850 and 1860. Morse's invention of the telegraph gave wire a tremendous push just before mid-century; later there was added impetus from the need to fence the western plains.

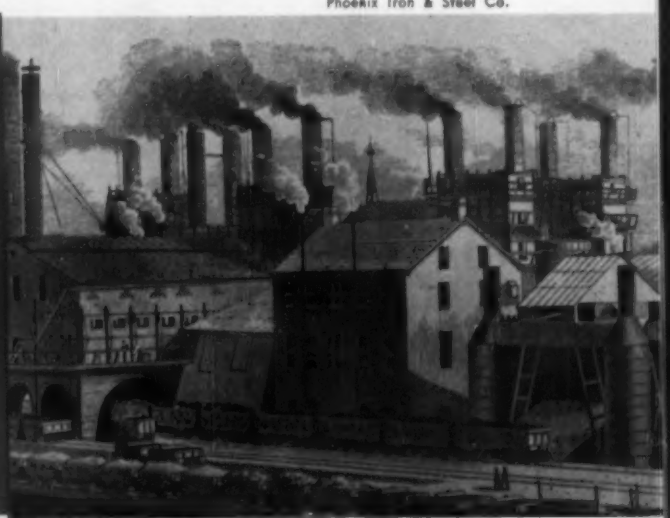
◆ BLAST FURNACE PROGRESS: The story of iron and its raw materials begins on the eastern seaboard and moves westward. Early blast furnace production was based on local

Lukens Steel Co.



WATER POWER drove this 19th century iron plate mill where charcoal blooms were slit, forged.

Phoenix Iron & Steel Co.



BLAST FURNACES, (1866) had just begun to use fireclay brick, made under 100 tons daily.

ores found at various points along the coast.

By 1860 the westward trend of pig iron production was underway, and by 1870 Pittsburgh was well established as the new center of the industry. Coke made from Connelsville coals had become the accepted blast furnace fuel, in place of charcoal and anthracite, which had first supplied the eastern furnaces.

The year 1880 saw a new, larger steel plant building at the mouth of the Calumet River in Chicago, where along the southwestern shore of Lake Michigan steel production today exceeds that of the Pittsburgh district.

In 1892 the Merritt Brothers made their first iron-ore shipment from the Mesabi Range, which has since furnished the bulk of the ore to feed the American iron and steel industry through its great growth, and sustain it through two world wars.

The famous Soo locks are 100 years old this year. From their opening to the end of the 1954 season 3,263,003,544 net tons of ore passed through them.

As the high grade, open pit mines run leaner, beneficiation of Mesabi taconite (with nearly $1 billion in plants already planned) promises that the famous range will continue an important source of raw material to the steel industry of the U. S. Meanwhile, rapid development of rich reserves of ore in friendly countries is beginning to ease the drain on the Mesabi.

The 6-Ton Furnace

The blast furnace at mid-century was a crude affair with a capacity of one to six tons a day. It was 20 to 30 ft high and shaped like a truncated pyramid, little changed from the Revolutionary War models. This despite the fact that the hot blast had been invented some 30 years before (Neilson, in Scotland, 1828).

But as the iron industry moved west the size of furnaces increased. By 1880 units rated at nearly 100 tons a day were being built, though they required three times that amount of coke.

Charcoal had been the principal fuel, until overtaken by anthracite coal in 1855, which in turn was overtaken in 1875 by beehive coke. The latter was made from bituminous coal, coke having been successfully used as blast furnace fuel for the first time in the U. S. in 1859 at the Clinton Furnace in Pittsburgh.

Production of beehive coke rose rapidly. By 1871 about 30 pct of iron was made with coke as fuel and by 1875 it was 42 pct. After that beehive coke remained king for another 20 years.

The by-product coke oven, although it had operated in Europe for a number of years with reasonable success, was not used in the U. S. prior to 1893, when the Solvay Process Co. put into operation 12 Semet-Solvay ovens at Syracuse, N. Y. But not until 1895 was by-product coke produced for blast furnace use, beginning with installation of 60 Otto-Hoffman Ovens by Cambria Steel Co., Johnstown, Pa.

Several installations of both types of ovens were made in the next few years. But not until the advent of the cross-regenerator type oven developed by Heinrich Koppers (four batteries were installed in 1908 at the Joliet plant of Illinois Steel Co.) was the by-product oven ready for its sensational rise.

An important reason for the rapid rise of the by-product oven was that it made for lower costs through higher yield of coke and through recovery and use of gas, tar, and other by-products.

Foresight in building ovens at points of coke consumption also facilitated blending of different coals, thus making useable much otherwise unsuitable coal.

Enter Sir Henry Bessemer

The bessemer process: The pneumatic converter process was developed independently by William Kelly of Eddyville, Ky., and Henry Bessemer of England. Bessemer's patent was issued in 1856; and although Kelly did not apply for a patent until 1857, he was able to prove that he had worked on the idea in 1847.

Lacking financial means, Kelly was unable to perfect his invention and Bessemer, in the face of great difficulties and many failures, developed the process to a high degree.

The first commercial Bessemer converter in the United States, a 2½-ton vessel, was built at Wyandotte Iron Works, Wyandotte, Mich., in 1864. However, a Kelly converter was used experimentally at Cambria (Bethlehem) Steel Works, Johnstown, Pa., as early as 1861. In 1856 Robert Mushet, of England, patented a

Wheeling Steel Corp.



NINETEENTH CENTURY mule has since been replaced by electric trucks in the nail mills.

process to add manganese to the converter to overcome the problem of sulfur in the iron.

One of the U. S. pioneers in development of the Bessemer process was Alexander L. Holley. Acquiring rights to the Bessemer patent, he built a plant at Troy, N. Y., which began operations in 1865.

Holley acted as consulting engineer on most of the plants erected in the first 10 to 15 years of development of the process in the U. S. He is credited with invention of the detachable bottom, which permitted replacement of the bottom without excessive loss of production when repairs were necessary.

In 1889 William R. Jones of the Edgar Thomson Works (now part of U. S. Steel) conceived the idea of the hot-metal mixer. By acting as a holding reservoir it promotes uniformity of pig iron, conserves heat, and permits independent operation between blast furnaces and converters.

• OPENHEARTH STEEL: Openhearth steel resulted from the work of Karl W. Siemens, a British naturalized citizen, with later improvement by the Martin brothers of France. Thus the original name Siemens-Martin process.

As early as 1868, a small openhearth furnace was built at Trenton, N. J. But satisfactory steel at reasonable cost did not result and the furnace was abandoned. Later, S. T. Wellman designed and built a successful furnace which was operated at Boston in 1870.

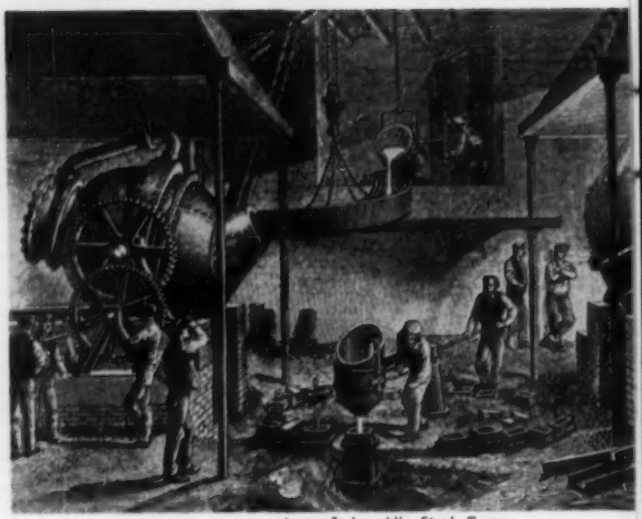
Openhearth Use Spreads

Following this success, similar furnaces were built at Nashua, N. H., and in Pittsburgh, the latter by Singer, Nimick and Co., in 1871. The Otis Iron and Steel Co. constructed two 7-ton furnaces at their Lakeside plant in 1874. Two 14-ton furnaces were added to this plant in 1878, two more of the same size in 1881, and two more in 1887. All of these furnaces had acid linings, using a sand bottom for the hearths.

A furnace with a basic bottom, rammed from Austrian magnesite, produced basic steel at the Otis plant in January, 1886. Production rate on the basic furnace was so low compared to that normally achieved with an acid bottom that the basic bottom was torn out after four months, and replaced by an acid bottom.

Following the Otis installations, the following companies also installed openhearth furnaces: The Cleveland Rolling Mills (later American Steel and Wire Co.); The Pennsylvania Steel Co. (later Bethlehem Steel Co.); the Schoenberger Works (later American Steel and Wire Co.); and Carnegie, Phipps and Co. (now Homestead Works of U. S. Steel Corp.)

It was in the last-named plant that commercial production of steel by the basic process



Jones & Laughlin Steel Corp.

CHARGING BESSEMER and pouring ingots, 1891, when 83 pct of U. S. output was bessemer steel.

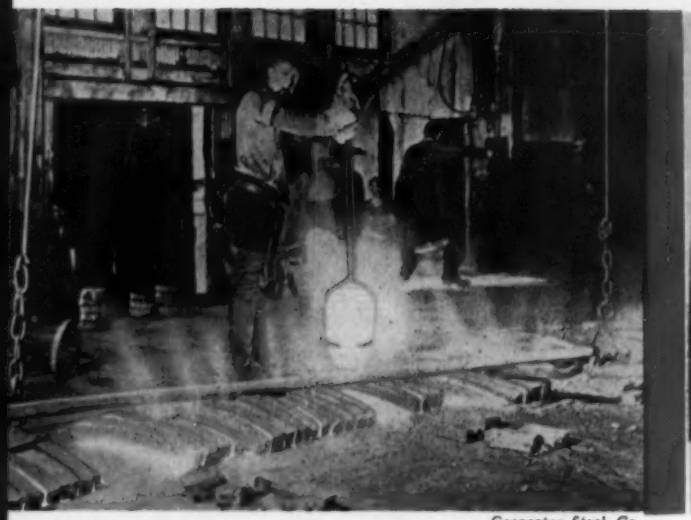
was achieved first, the initial heat being tapped Mar. 28, 1888. By the close of 1890 there were 16 basic openhearth furnaces operating. From 1890 to 1900 magnesite for the bottom began to be imported regularly and the manufacture of silica refractories for the roof was begun in American plants. For these last two reasons, the construction of basic furnaces advanced rapidly and by 1900 furnaces larger than 50 tons were being planned.

While the bessemer process could produce steel at a possible lower cost above the cost of materials, it was restricted to ores of a limited phosphorus content and its use of scrap was also limited. The openhearth was not subject to these restrictions, so that the annual production of steel by the openhearth process increased rapidly, and in 1907 passed the total tonnage produced yearly by the bessemer process. Total annual production of bessemer steel has decreased rather steadily since 1907. The main reasons were the flexibility of the openhearth process, with respect to its ability to produce a wide range of steels of many compositions, and its ability to use a large proportion of steel or iron scrap, if necessary.

Today steel production by processes breaks down about like this: openhearth, 90 pct; electric, 7 pct; bessemer, 3 pct. By capacity the breakdown is openhearth, 87.6 pct; electric, 8.6 pct, and bessemer 3.8 pct.

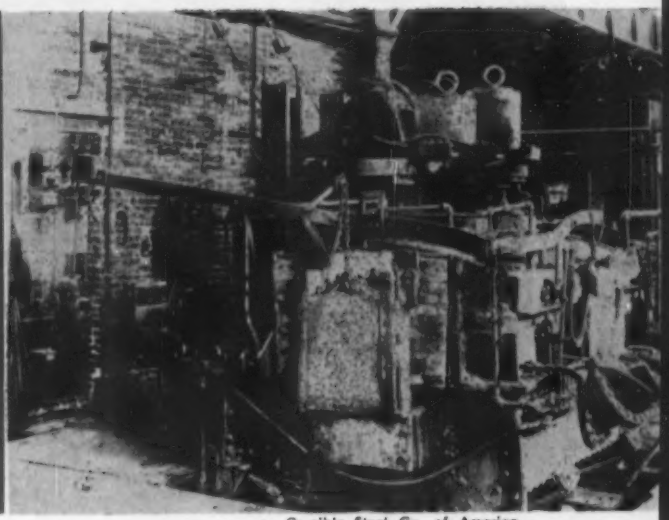
Electrics Gets Their Start

Electric furnace steel: Discovery of the carbon arc by Sir Humphrey Davy in 1800 paved the way for the electric arc furnace. But practical beginning of the art was the work of Sir William Siemens, who in 1878 constructed, op-



Carpenter Steel Co.

TOOL AND ALLOY steels were melted in crucibles in 1890 as they were for hundreds of years.



Crucible Steel Co. of America

FIRST ELECTRIC furnace in the U. S. was imported from France, started up in 1906.

erated and patented furnaces operating on both the direct-arc and indirect-arc principles.

Electric power was scarce and expensive. Also carbon electrodes were of poor quality. Commercial electric furnaces had to await developments in both these industries.

The first successful commercial direct-arc steelmaking furnace was placed in operation by Heroult in 1899, in France.

First in this country was a Heroult furnace installed at Halcomb Steel Co. (Crucible Steel Co. of America), Syracuse, N. Y., producing its first heat Apr. 5, 1906.

This was a single-phase, two-electrode, rectangular furnace of 4-ton capacity. Two years later a similar but smaller furnace was installed at Firth-Sterling Steel Co., McKeesport, Pa., and in 1909 a 15-ton, three-phase furnace was installed in South Works of Illinois Steel Co. (U. S. Steel). The latter was at that time the largest electric steelmaking furnace in the world. It was round instead of rectangular, operated on 25-cycle power at 2200 v.

First electric furnace for production of steel for commercial castings was that of the Treadwell Engineering Co., Easton, Pa., first operated in 1911.

About the same time General Electric Co. began experimenting with direct-arc electric furnace designs with an eye to developing a market for equipment. Others followed: Snyder, Ludlum, Vom Baur, Booth-Hall, Moore, Green, Swindell, and Volta. These were the forerunners of the modern electric furnace.

◆ MILLS, POWER: Beyond basic iron and steelmaking it is impossible to do justice to the work of the hundreds of men who developed the mills, equipment and processes to produce the finished products that have revolutionized American industry during the past 100 years.

Highlights include: Invention of cold rolling (Stanley Works, 1870), the first continuous hot strip mill (Armco, 1923), followed by development of cold rolling; development of modern types of tool and alloy steels (known in the 1870's but hardly commercialized until the 20th century); and the rapid recent growth of stainless steels (introduced commercially in 1912).

The growth of and the ability to control electric power on mills have been indispensable to the development of rolling. From 1903, when two 1500-hp motors first drove a light rail mill to today's 12,000-hp double armature twin drive unit was a long step. Electronic controls that permit synchronization of multiple mill stands are another milestone passed within the past few years.

Makers of rolls and refractories, furnaces, lubricating systems and handling equipment teamed with mill builders and operators to produce products and tonnages which would have been considered fantastic at the turn of the century.

Stainless Output Soars

Stainless and alloy steels: It is still too early to evaluate the full impact of stainless steels on the U. S. economy. In 21 years (1934-1954) production soared from less than 50,000 to more than 824,000 tons a year. Corrosive, high and low temperature and high stress applications are well known. Though engineering data is extensive, new applications are constantly being found.

While alloy steels were by no means unknown 75 and more years ago, little was known about their properties or manufacture. Around the

turn of the century early investigators working with electric furnaces, developed ferroalloys of chromium, silicon, titanium and tungsten. Vanadium was ushered in at about this time and soon became a factor in high speed steels. A few years later molybdenum came into use.

Nickel, one of the oldest known alloying elements, had been widely used in armor plate but volume fell off after World War I with the disarmament program. So the International Nickel Co. undertook a vigorous research program, soon introduced a whole new family of nickel alloy steels and nickel alloys.

Heat treating, discussed in detail in its own section, made possible tremendous strides in steel, including reduction of alloy content. Isothermal diagrams developed by U. S. Steel revolutionized the metallurgical approach, aided development of the National Emergency Steels for World War II.

The high-strength low alloy steels introduced before World War II received little recognition until after 1945. Since then their ability to reduce deadweight by 20 to 30 pct, plus better corrosion resistance, brought growing acceptance for freight cars, trucks, mining and road building machinery, etc.

◆ TOOL STEEL: The oldest form of steel is currently produced in about 80 identified types, covering water hardening, air hardening, high carbon, high chromium, shock resisting, hot work and high speed tool steels. In 1855, as it had been for hundreds of years, steel for tools was made by the crucible process, and it was not until the electric arc furnace came to the fore in the 20th century that "modern" tool steels were available. The trend has since been to emphasize the performance properties and tailoring of the composition and steel manufacture to attain those properties.

◆ FLAT-ROLLED: Thin flat-rolled products (sheet, strip, tinplate, etc.) now account for more than 40 pct of steel production in the United States. In 1923, the year the continuous mill was introduced, the figure was about 20 pct and quality was vastly different. Steel companies which moved with this revolution turned in better than average profit statements.

Galvanizing Gains

Continuous galvanizing has gone through intensive development since the early 30's. The result is several modern processes of hot dipped and electrolytic galvanizing that produced about three quarters of the record breaking output of galvanized sheets in 1954, some 2.5 million tons. Twenty two hot dip and two electrolytic lines operated in 1954; by the end of this year five more hot dip lines will be in operation.

Electrolytic tinplate, introduced commercially in 1937, proved invaluable in World War II when Japan cut off eastern tin, now outsells hot dipped by 3 to 1. Grain oriented silicon strip is now revolutionizing electrical sheet.

◆ MARKETING: The trend toward centralization of steel production which began in the early 20th century has reversed itself. Changes in ore sources, growth of electric furnaces and of specialty steels have contributed. In 1920 the Pittsburgh-Youngstown steelmaking district accounted for 48 pct of the nation's ingot capacity. Chicago had 18.3 pct; Cleveland-Detroit, 6.3; the West, 2.9; and the South, 2.8.

U. S. Steel Corp.



OPENHEARTHS tapped over 100 tons per heat in early 1900's when this photo was made.



WROUGHT IRON was hand puddled from 1784 to the 1820's, when mechanization took over.

Today Chicago taken separately leads Pittsburgh by about 2 million tons. The Pittsburgh-Youngstown district is now down to 35.2 pct of the national total. Cleveland-Detroit has jumped to 10.4 pct of the total while the West and the South each have 5.6 pct of that total.

With changing emphasis on steel producing areas there came changes in marketing, though not for the same reasons. At the middle of the 19th century most iron, and what little steel there was, were sold locally. Like their customers, these ironmakers existed almost entirely on local raw materials.

By the end of the 19th century, rails, structurals and a few other products were being sold nationally. The early 20th century was the beginning of the era of integrated steel companies. As they built up their mills they reached further and further out for markets. Seaboard mills shipped part of their output overseas and to the West Coast. This was the era of Pittsburgh Plus (basing prices on freight from Pittsburgh regardless of mill location).

With abolition of Pittsburgh Plus by court order (1924) the basing point system came into being. Eventually, steelmakers established more than 60 basing point cities.

For a given product the buyer's cost was the price at the nearest basing point plus freight from that point to his plant. The mill at the basing point charged the basing point price plus this freight. A more distant mill absorbed enough to meet that delivered price if he wanted the business. The U. S. Supreme court outlawed the basing point system in 1948. Prices from then on have been f.o.b. mill.

The steel warehouse grew up with the steel industry; there are 30 more than 100 years old.



Armco Steel Corp.

FIRST CONTINUOUS hot mill, installed in 1923, began revolutionary flat-rolled trend.

Starting as importers of English and Swedish iron, their next stage was as mill agents. When steel products became more diversified about the turn of the century these agents—to meet market needs—began handling the products of more than one mill.

Some 20 to 30 years ago they began to add more elaborate cutting facilities and to do more specialized services. Today, many have slitting, rolling and other facilities. With this growth they doubled their percentage share in steel distribution, quadrupled their volume.

Yoder Co.

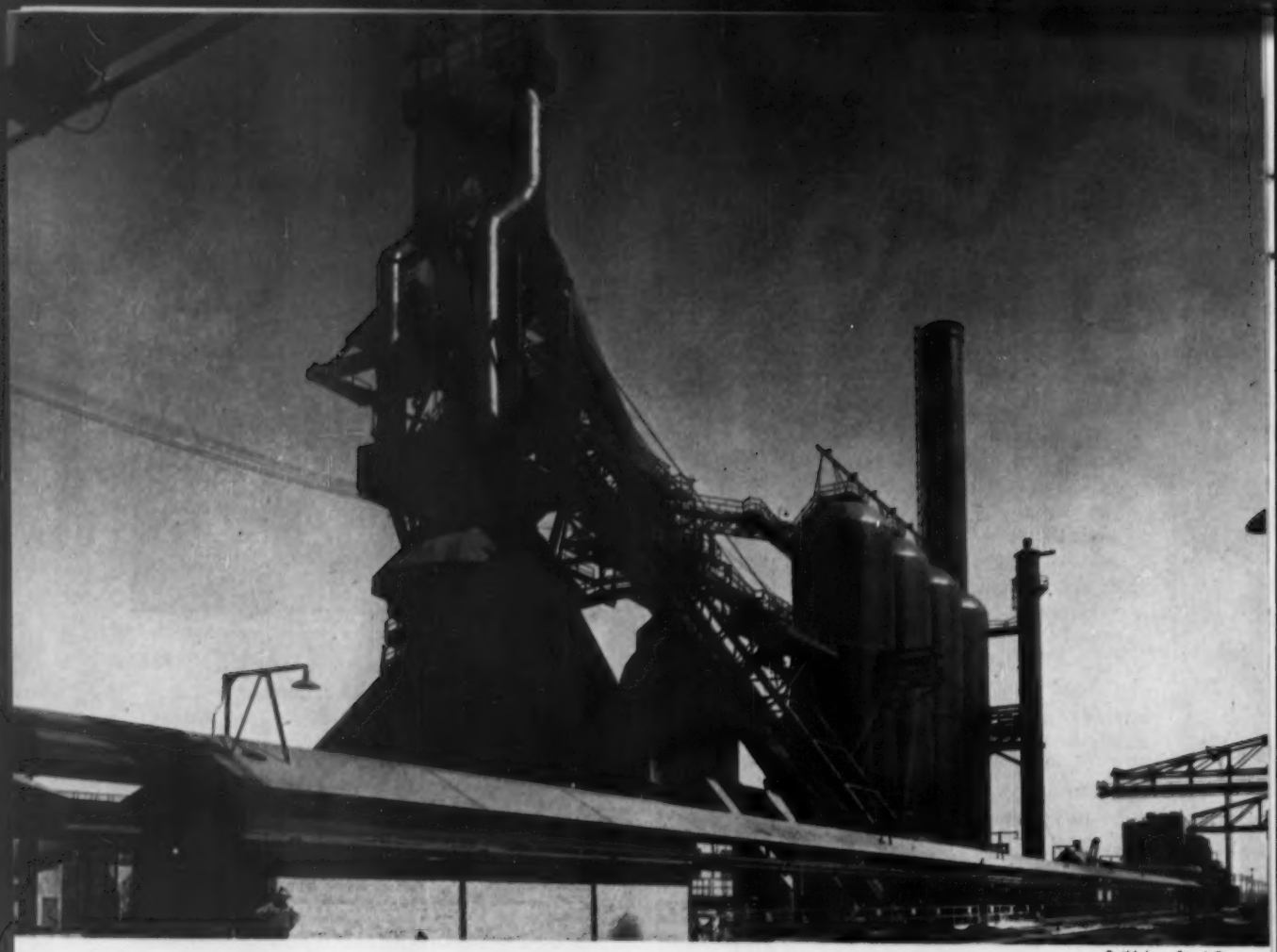


ONE OF THE earliest large continuous weld pipe mills installed in 1930-1931.

Bethlehem Steel Co.



HAND SHEET MILLS required large crew. Work was rugged, output low and quality uneven.



Bethlehem Steel Co.

WORLD RECORD, over 61,000 tons in a month, was set by this Sparrows Point blast furnace.

IRON AND STEEL...

TAPPING a heat from a 550-ton openhearth, one of the largest in the world.

Weirton Steel Co.



the present

THE UNITED STATES iron and steel industry now has 430 plants making or finishing iron or steel in 270 communities in 31 states. The industry's postwar $7 billion expansion and modernization program raised annual steelmaking capacity to 125,828,100 net tons, an increase of about 34 million tons since January 1, 1946, including some 15 to 20 pct of capacity as a standby reserve for emergency. Another 75,000,000 tons of capacity may be installed during the next 25 years if the population continues to increase at presently estimated rates and the scale of living of the majority of Americans continues to improve.

◆ COAL WASHING: Increasing ash content of metallurgical coal, due partly to depletion of low ash coal deposits in World War II and partly to mechanized mining, necessitated coal washing and blending to avoid excessive ash in coke for the blast furnace.

Mobile machines for mechanical loading of coal increase coal output and decrease mining costs, but increase the refuse content of mined coal. In smelting iron ore, high ash coke requires more flux (for increased ash) and produces larger slag volume and smaller pig iron output than low ash coke.

Additional coal washing equipment was installed for coals in which impurities are mainly associated with heavy gravity refuse; for some other coals, heavy media processes of coal separation are used; and blending of coals is employed to reduce the variability of injurious impurities or coal characteristics. Also, selective mining is employed to shoot the coal down, leaving slate in place while loading the coal, and then shooting down the slate for separate loading.

In nine postwar years annual coke capacity increased from 60,420,740 to 72,684,750 net tons as of January 1, 1955.

◆ NEW BLAST FURNACES: Heavier demand for pig iron was met by building and modernizing blast furnaces and increasing their output. Each of nine new furnaces can produce over 500,000 net tons of iron a year; one made 61,424 tons of iron during May, 1954, a world record. From 1946 to 1955, blast furnace annual capacity rose from 67,340,590 to 83,971,100 net tons.

Sintering of fine ores is a major postwar development in raw material preparation for the blast furnace. In the 1946-53 period sinter production increased from about 7,600,000 to 21,565,865 net tons. The process once applied only to flue dust agglomeration is now used also on fine ore and beneficiated ore, and is likely to increase in importance with the expansion of taconite beneficiation.

Carbon hearths replaced ceramic hearths in over 100 blast furnaces for the purposes of reducing or eliminating hearth breakouts and to increase hearth diameter.

A modification of Henry Bessemer's idea of moderately increased over-all pressure for a blast furnace was tried experimentally in 1944 in a new 27 ft diameter furnace. Thus began the large scale study of "top pressure," of increasing the gas pressure at the top of the furnace from about 1.2 psi to higher pressures up to about 10 psi. In operating the furnace under increased top pressure, the velocity of gas through the furnace can be decreased while the furnace is blown at substantially higher rates.

Increased iron production and decreased coke rate and flue dust production have been reported for top pressure operation. Of greater importance, in the years ahead, may be the smoother operation and better production control obtained by top pressure practice.

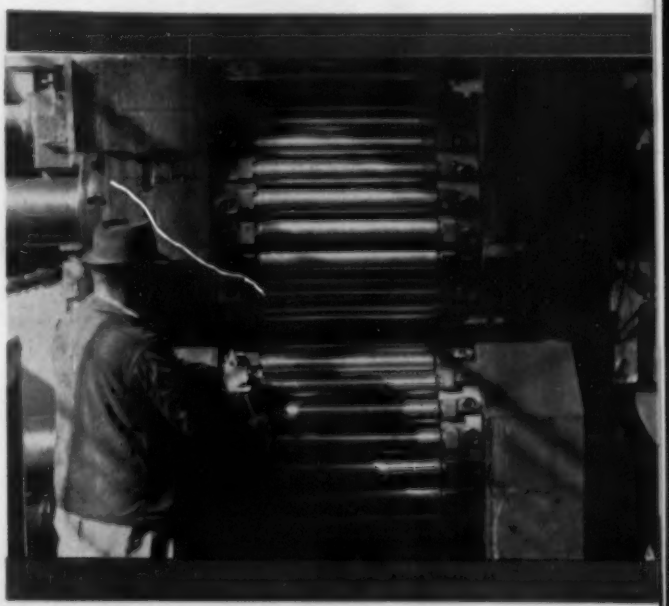
The sizing of ores as a means to increase iron output and decrease coke consumption is described under "Future."

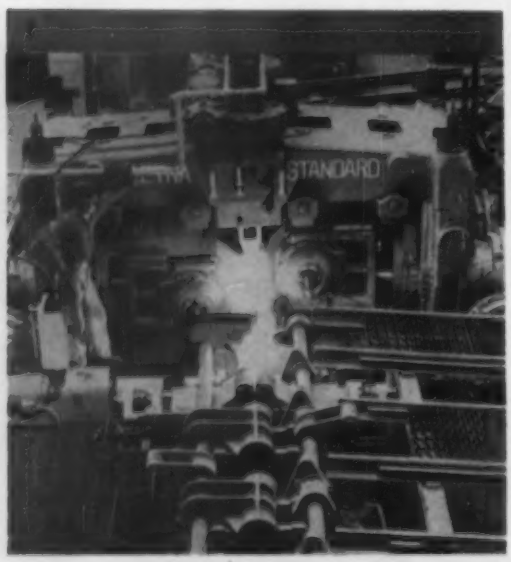
The postwar use of oxygen in pig iron blast furnaces has not resulted in the amount of coke saving suggested by early trials. The most promising use of oxygen in blast furnaces appears to be in making spiegeleisen. It is possible that changes in blast furnace design and preheating the blast to higher temperatures may enable the use of oxygen enriched air to achieve significant coke savings, decreased volume and velocity of gas, decreased flue dust production, increased rate of burning the coke and higher hearth temperatures.

◆ MORE OPENHEARTHS: Increase in openhearth capacity, during 1946-1955, from 81,236,250 to 110,234,160 net tons is the major part of the postwar expansion of steelmaking capacity. From 1945 to 1954 the average capacity per heat increased 37 pct while the number of furnaces dropped from 990 to 924. Three of the postwar developments that increased the tons per hour rate of openhearth steelmaking are described below.

Experiments in 1949 indicated that steel output could be increased 15 to 20 pct if fast scrap charging could be geared to the high melting rates obtained with oxygen enriched flame. Faster scrap charging was obtained by means of elevators to carry loaded buggies from the basement of the furnace building to a position directly in front of the openhearth, thereby saving half of the three hours of charging time required by conventional charging equipment. In addition, the elevator or "scrap hoist" method provides for simultaneous charging of two or more furnaces without interference with melting and refining operations in other furnaces.

The use of oxygen in the flame to speed the melting of scrap and limestone and of oxygen injected into the bath to reduce refining time and





increase bath depth is one of the outstanding postwar developments in steelmaking which in turn had to await the development of economical methods for large scale oxygen production. The increased steel output attributable to these uses of oxygen is estimated at 2½ to 10 pct, depending upon the nature of the charge, furnace characteristics and steelmaking practices.

Selective heating up rates for openhearths after rebuilding has increased furnace availability by an amount equivalent to 79 hours a year a furnace. Those rates are 125, 150 and 300 F per hour for roof temperature ranges of 100-600, 600-1200 and 1200-2000 F, respectively. The faster rates at the higher temperatures are based on the different expansion rates of silica brick. Use of selective heating up rates throughout the





industry could increase steel output by at least 780,000 tons a year.

Minor but significant developments also have increased basic openhearth steelmaking capacity since 1945. Improved bricklaying methods have decreased down time for rebuilding furnaces. Extra cranes of larger capacity, larger pouring platforms, extra charging machines, enlargement of openhearth doors to admit larger charging boxes, additional instrumentation and automatic controls, increase in the size of regenerator chambers, larger flues, larger cinder pots to handle slag in one operation, new refractories for higher operating temperatures, more careful selection of scrap by size and quality and more careful scrap preparation to increase the weight of scrap in charging boxes have speeded steelmaking and increased steel output.

◆ THE TURBOHEARTH'S POSSIBILITIES: This basic lined furnace resembles a stemless brandy inhaler; in front view, a square box topped by a truncated pyramid. It is mounted on trunnions.

Molten iron of basic pig grade is surface blown with air or oxygen-enriched air to produce semikilled carbon steel of structural grade having mechanical property values with the same limits as basic openhearth steel of the same composition.

Reported experimental results on 12 minute average blows of 1000-lb charges indicate: nitrogen can be held to about 0.003 pct and carbon, manganese and silicon oxidized to below 0.03, 0.01 and 0.01 pct, respectively; up to 50 pct sulphur and up to 97 pct phosphorus can be removed; burning of half the carbon to carbon dioxide provides a substantial part of the temperature gain; and fumes are less dense than those from the acid bessemer.

1 PIERCING A BILLET, one stage in the manufacture of seamless steel tubing.

2 PLANETARY HOT MILL rolls 2¼ in. stainless steel slabs to 0.100 sheet in a single pass.

3 Top: ELECTRICAL and stainless strip are rolled on this new mill designed for 15,000 hp.

3 Bottom: BIG 4000-HP motors for new hot strip mill.

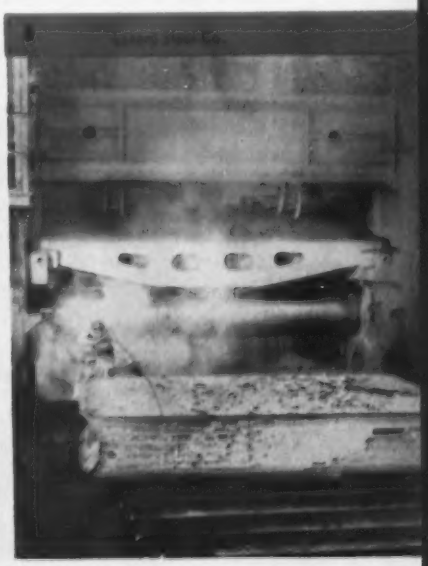
4 WORLD'S FASTEST 5-stand cold reduction mill.

5 CLUSTER MILLS are used to cold roll specialty steels to light gages, close tolerances.

6 LARGEST plate mill in U. S. can roll 66-ton ingots.







◆ ELECTRIC TREND UP: Proximity to markets and availability of cheap scrap appear to be more important factors in the postwar increase in electric furnace steelmaking capacity than technical developments. The annual capacities as of Jan. 1, 1946, and 1955, are 5,500,290 and 10,807,110 net tons, respectively. Until the end of World War II, the basic electric furnace produced mainly alloy, stainless and tool steels, and a comparatively small amount of carbon steels. Since then it has produced carbon steels in increasing amounts.

Basic electric furnaces have been installed by nonintegrated steel producers to supply local markets remote from steel producing areas. Low capital outlay per ton of capacity, scrap availability for 100 pct scrap charges and high production rates for small size heats were attractive considerations for producing carbon steel grades normally made in the openhearth. In addition, some producers were able to avoid capital expenditure for primary breakdown rolling mill equipment by teeming billet-size ingots; that practice also saved the cost of converting ingots and blooms to billets.

During the same period, when electric furnace capacity was available, carbon grades conventionally made in the openhearth or bessemer also were produced in the basic electric furnace, including rephosphorized and resulphurized steels.

The electric furnace appears to be limited to cold metal practice, although some hot metal experimental heats have been made. Where cheap scrap is available, the electric can produce small heat tonnages at a lower ingot cost than the openhearth.

For some purposes, electric furnace steel may be poorer in quality than openhearth steel due to contamination from incidental elements (tramp metals) in the higher percentage of scrap in the charge. However, except for element contamination, electric furnace steel is as good as or better than openhearth steel.

With cheap pig iron, the material cost and cost of ingots are about the same for each furnace. With cheap scrap, the electric furnace material cost may be as much as $8 a ton less and cost of ingots $7 a ton less than those of the openhearth.

Electric furnace operating cost is about $4 an ingot ton higher than that of the openhearth on account of electrode cost and the higher cost of heating, despite its higher thermal efficiency.

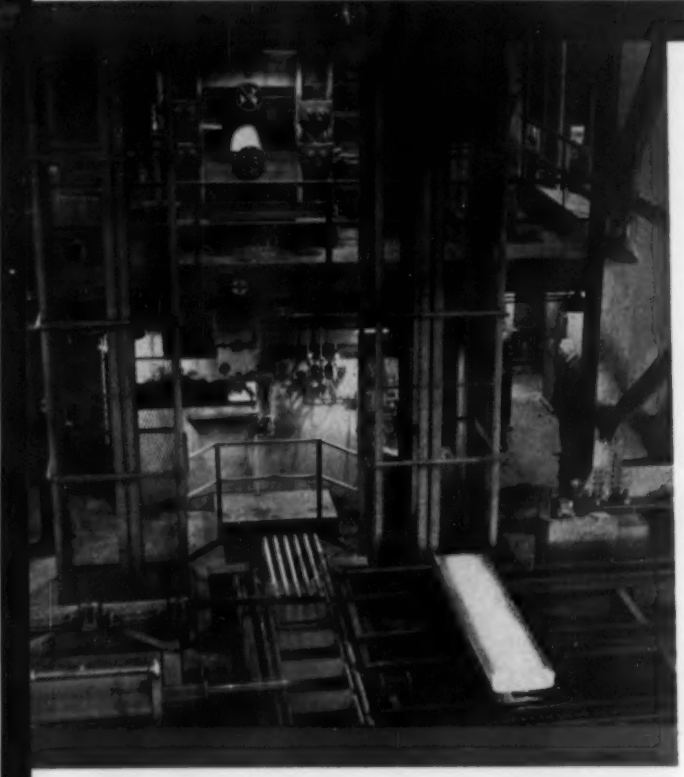
Over-all cost, after fixed charges, of electric furnace ingots is estimated at $2.60 to $4 a ton less than that of the openhearth. Installation cost and capital charges of electric furnace shops are about 60 pct of those of openhearth shops of similar capacity. (The foregoing cost and capital estimates are based on 1953 data.)

◆ VIRILE BESSEMER: While basic openhearth and electric furnace steelmaking annual capacity increased significantly during 1946–1955, acid bessemer capacity decreased from 5,154,000 to 4,787,000 net tons, and the ratio of bessemer capacity to total steel making capacity dropped from 5.6 to 3.8 pct. Yet, the oldest large scale steelmaking process displayed its postwar virility and versatility in the development of killed acid bessemer steel for seamless pipe and production of over a million tons of that pipe.

Another development to match openhearth steel is striving for commercial scale operation: it is sometimes called the "oxygen process." It was developed in Europe and licensed in America. It should not be confused with oxygen enrichment of the blast in a bottom blown acid bessemer sometimes used to decrease blowing time and increase the amount of scrap charged (from about 11½ to 17 pct). In the Austrian version of the oxygen process, a jet of oxygen (98 pct pure) is directed downward at the surface of molten iron in a solid bottom basic lined "converter." Claims for the process include: steel low in nitrogen (0.003 to 0.007 pct), steel with characteristics similar to those of basic openhearth steel, and versatility in rapidly producing small tonnages of various grades.



◆ THE CONTINUOUS MILL: Both technically and economically, the continuous mill ranks high among those inventions having far-reaching effects on modern man. During 1953, the year of maximum steel output in the United States, net shipments of steel products totaled about 80 million tons, of which 32 million plus tons were sheets, strip and tin mill products, or 40.5 pct of total net shipments. The percentage would be greater if it included flat rolled prod-



7 ELECTROLYTIC TINNING line. Process, started during World War II, now tops hot dipped output.

8 CONTINUOUS CASTING takes steel from molten to semifinished state. View shows a cast slab.

9 HOT EXTRUSION, achieved with a glass lubricant, handles tough alloys, unusual shapes.



ducts which were converted into further finished products. In effect, at least two-fifths of the industry's output depends upon the continuous mill. That tremendous output, tonnagewise and percentagewise, is merely the producing side of the continuous mill. Of far greater significance is the consuming side in which end product manufacture has undergone marked change in fabrication methods and in new product applications since the days of the hand mill.

◆ SHEET TECHNOLOGY: Consumer requirements for flat rolled products have necessitated further developments in steelmaking and finishing that utilize more fully the capabilities of continuous rolling. For example: requirements for drawing quality cold rolled carbon steel automobile roof panel sheets, 70 by 90 in., call for not over 2 pct scrap or reported repairs. That means a maximum of only two serious defects in 4375 sq ft of sheets (100 sheets, 70 x 90 in.).

The manufacture of drawing quality cold-rolled carbon steel sheets employs the latest developments in sheet technology. In steelmaking, ladle limits may be set on 10 elements, such as C .07-.08, Mn .30-.40, P .010 max., S .025 max., Si .010 max., Cu .10 max., Cr .02 max., Ni .02 max., Mo .01 max. and Sn .015 max., in per cent, for rimmed steel; for aluminum killed steel the carbon and manganese are slightly lower.

Twenty-ton ingots, from heats of several hundred tons each, are rolled, cropped and cut into 8-ton slabs to yield 16-ton coils in widths of 70 to 77 in. with only one weld, as well as welded 25-ton coils. One weld means less weld loss and greater uniformity of product. Continuous scarfing by acetylene-oxygen torches removes about 3/32 in. from each surface of the slab.

The rolling of the reheated slabs into hot bands on the continuous hot mill is subject to controls on the shape, gage, surface, scale condition and metallographic structure; particular attention is given also to finishing and coiling temperatures and to entire surface coverage by high pressure sprays. Cooled hot bands are decoiled for continuous pickling in dilute sulphuric acid, rinsing and oiling.

In the cold reduction mill, the rimmed steel is cold reduced 60 to 65 pct and the aluminum killed steel 38 to 45 pct, with most of the reduction in the first stand. In the last stand the rolls are blasted to produce a dull surface on the coil, which avoids sticking or welding of adjacent layers in subsequent annealing and aids the consumer's die drawing operation. The cold reduced steel may approach 90 Rockwell B for 60 pct cold reduction in thickness. Consequently, annealing is performed to restore ductility. The product in coils or cut lengths is annealed in radiant tube furnaces under a slightly reducing protective atmosphere, for periods up to several days for 400-ton charges of large coils.

For exposed parts which must be free of surface disturbances (when the sheets are properly

roller-leveled just prior to stamping), the annealed steel is cold rolled to reduce the yield point elongation and thereby enable the sheets to be roller leveled without "breaking" or "fluting."

In-process inspection for control purposes is followed by a check of the finished product for dimensions, hardness, ductility, yield point elongation, yield strength, tensile strength, grain size, structure and cleanliness.

Only with modern sheet technology, comprising a chain of controls that extend from primary steelmaking raw materials to the shipping platform, can a batting average of .980 be maintained on such drawing quality sheet.

◆ EXTRUSION: In the Ugine-Sejournet process, developed in France and licensed in America, steel is heated to forging temperatures, covered with glass and extruded through a die to form bars, tubes and products having cross sections that are not readily or economically formed by other means. The glass becomes molten and acts as a lubricant and heat insulator, thereby enabling the steel to be shaped without damaging the steel or the die.

◆ ELECTROLYTIC TINPLATE accounted for 5.8 pct of total steel shipments in 1954. The 3,680,467 tons shipped was nearly three times the shipments of hot dip plate. Coating weights of 0.25, 0.50, 0.75 and 1.00 lb per base box (lb/bb)* were plated on 34 electrolytic lines; two more are under construction.

* A base box is 31,360 sq in. of tin plate, equivalent to 112 sheets 14 by 20 in. One pound per base box corresponds to a tin coating thickness of about 60 millionths of an inch on each side.

No. 100/25 differentially coated electrolytic tinplate, having the equivalent of 1.00 lb/bb coating on the No. 100 side and 0.25 lb/bb on the No. 25 side is an important postwar development. Other coatings have also been produced, such as 25/50, 25/75, 50/75 and 50/100.

Originally developed to conserve tin, differentially coated plate provides a container with an inside coating sufficiently thick to resist attack of the contents and an outside coating adequate for processing, printing, labeling and atmospheric conditions.

In a typical horizontal two-decked plating line for differential coating, the tin is deposited on one side and then on the other, so that coating weights on each side are independently controlled.

◆ ALLOY CONSERVATION: The Korean War accelerated the production of steels containing boron to conserve nickel, chromium and molybdenum. Previously a few grades of steel treated with boron had been successfully used on a limited scale. Many additional grades were developed by cooperation among steel producers and users to save up to 50 pct of scarce alloying elements formerly required for many engineering and constructional steels.

Minute amounts of boron, such as 0.0005 to 0.003 pct increase the ability of steel to harden in depth and become appreciably stronger when properly heat treated: it is estimated that 0.003 pct boron has an effect on the hardenability of steel equal to 0.79 pct nickel, 0.27 pct chromium or 0.23 pct molybdenum.

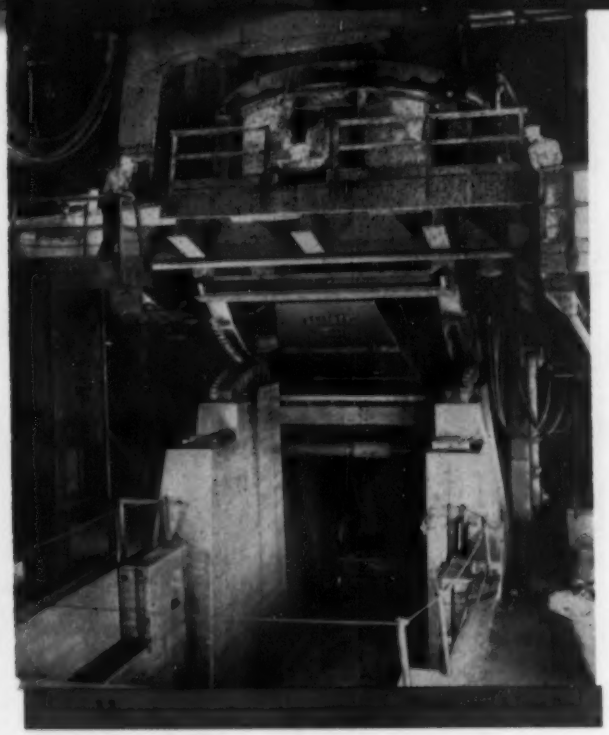
High strength low alloy steel surged upward since 1946 to an impressive 1953 peak of over 700,000 tons shipped for construction, automotive, railroad car, oil and gas drilling, mining, agricultural, machinery, industrial equipment, container and air conditioning uses. This product embraces a group of proprietary steels with higher mechanical property values and greater resistance to atmospheric corrosion than are obtainable from conventional carbon structural steels containing copper.



The steel can be fabricated by shearing, gas cutting, punching, forming, riveting, welding, buffing, polishing and plating, and is intended for use without quenching and tempering treatment by the fabricator.

It is available as hot rolled bars and bar size sections, structural sections, plates and hot and cold rolled sheets and strip.

Minimum tensile and yield strengths are generally 70,000 and 50,000 psi, respectively; shear strength in the as-rolled condition is about 52,000 psi. The higher yield strength and corrosion resistance are utilized in saving weight, particularly of equipment in motion such as trucks and railroad cars. The superior shear strength is useful in frames of aligning equipment to realign heavy trucks, and for U-bolts and stake



10 OXYGEN LANCE inserted in openhearth is used to reduce carbon, cut overall heat time.

11 INDUCTION STIRRING unit mounted on bottom of electric furnace tilted for deslagging.

12 COLD DRAWING a bar. Cold finished bars account for 2 to 3 pct of total steel shipments.



braces on trucks. Resistance to denting and puncturing are other important properties of the steel.

◆ ELECTRICAL SHEETS: Grain oriented electrical sheet and strip for transformers, turbogenerator stators and magnetic amplifiers are iron silicon alloys of superior magnetic properties in which the direction of rolling coincides with a particular direction of the silicon ferrite grains. When the cube edge direction of the silicon ferrite lattice coincides with the path of the magnetic circuit, the magnetic permeability increases and the magnetostriction decreases, in comparison with sheet having randomly oriented grains. The net result is weight reduction and quieter operation of electrical equipment such as transformers.

The cube edge direction is the easiest to magnetize; the cube diagonal the hardest. Grain oriented sheet and strip have a maximum permeability of about 60,000; randomly oriented material of 1935 had 15,000; laboratory experiments on pure silicon ferrite gave 3.5 million; and 6.4 pct silicon ferrite heat treated in a magnetic field attained 3.8 million.

Grain oriented alloys have been evolving since the 1930's, following improvements in melting, casting, hot working, annealing, cold reduction and final annealing. Vacuum melting and casting may become important factors in future development of grain oriented electrical sheet and strip that is practically free of sulphur, hydrogen, oxygen and carbon.

◆ NEWS IN STAINLESS: The "17-4-6" and "18-5-8" chromium-manganese-nickel steels, precipitation-hardening stainless steels and the use of rare earth metals in some stainless steels are three important developments.

The 17-4-6 stainless contains: Mn 5.5 to 7.5 max; Cr 16.0 to 18.0; and Ni 3.5 to 5.5. The 18-5-8 grade contains: Mn 7.5 to 10.0; Cr 17.0 to 19.0; and Ni 4.0 to 6.0 Both also contain: C 0.15 max; P 0.060 max; S 0.030 max; Si 1.00 max; and N 0.25 max. Development of the new steels started in World War II when the nickel supply was conserved and continued during the Korean War. Nitrogen is intentionally present to aid austenite formation at high temperature; manganese is present to retain the austenite at room temperature and retard its transformation during cold working operations.

The 17-4-6 steel is used in place of Types 301 and 302 in some applications where machinability and forming characteristics are not essential; for the latter characteristics, the 18-5-8 steel is preferred to 17-4-6 because the higher manganese reduces the rate of work hardening. The 17-4-6 steel has been used in rail cars and truck trailer units. That steel has been fabricated by spot, seam, projection and arc welding. Precipitation-hardening stainless steels, such as 17-7 and 17-4 were developed to provide ductility for severe forming operations superior to

that obtainable in cold work-hardened conventional chromium-nickel stainless steels. Typical compositions are:

Grade	C	Cr	Ni	Al	Cu
17-7	0.07	17.0	7.0	1.1	...
17-4	0.04	16.5	3.75	...	3.75

Both compositions are produced as forging blooms, billets, bars and wire, and the 17-7 composition also as sheet, strip and plate.

Applications of the 17-7 grade include spherical pressure vessels, hand saws, springs, link chain, microswitches, aircraft fuselage sections and check valves for liquids and gases. The 17-4 grade is suitable for aircraft hoisting hooks, parts of seat ejection apparatus, compressor blading in gas turbines, aircraft landing gear parts and oilfield valves operating at low temperature.

Properties are selectively developed by the fabricator's heat treatment, and for some uses by a combination of cold work and heat treatment.

Rare earth metals in mischmetal,* used in ladle additions, improve the hot workability and yield of some austenitic stainless steels. It has been reported that as little as 0.08 pct cerium and lanthanum overcomes hot shortness.

The effects of the rare earth metals differ according to the melting practice. Some grades of austenitic stainless steels melted in an arc furnace required less mischmetal addition than when melted in a high frequency induction furnace.

* Mischmetal is an alloy of variable composition containing about 50 pct cerium (atomic No. 58), about 5 pct Fe, .1 to .3 pct Si, traces of Ca, C and Al, and about 45 pct of the elements having atomic Nos. 57 (lanthanum) and 59 to 71, incl.

In general, mischmetal appears to transform inherently hot short highly alloyed austenitic stainless steels into ductile alloys, and improves the hot workability of inherently ductile steels such as Types 308, 310 and 316.

Cerium fluoride additions to the ladle or molds or both improve the ingot surface and hot workability of austenitic stainless steels containing titanium as an alloying element.

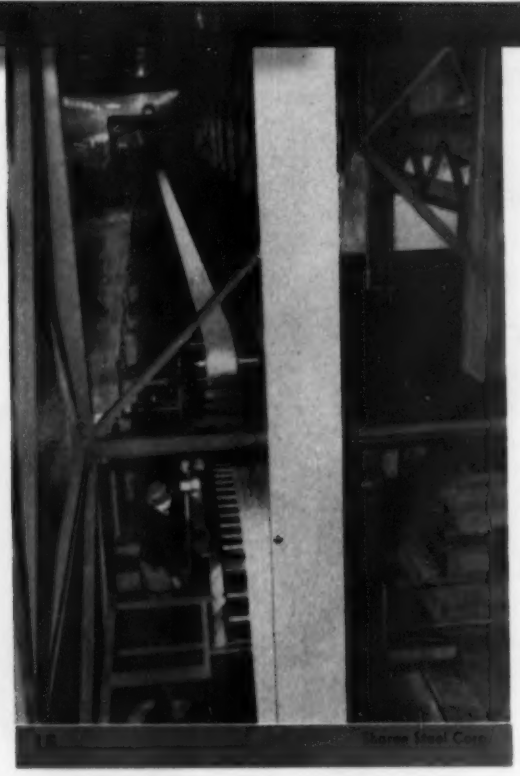
◆ SPECIAL ALLOYS: High temperature steels and other alloys have undergone intensive development during the past decade to provide materials for the new temperature ranges and the corrosive and erosive attack of gases of jet engines and gas turbines, and also for atomic energy and industrial applications.

Several families of wrought and cast materials have been developed for use above 1500 F, including austenitic stainless steels, austenitic superalloys and nickel and cobalt base alloys.





Many aspects of property evaluation must be considered in high temperature applications: Getting the material into the shape of the end product may necessitate casting instead of rolling or forging; the strength of the material at elevated temperature can be affected by the limitations of welding, scaling resistance and carbide precipitation; performance is affected by thermal expansion and thermal conductivity. No metal, alloy, ceramic or cermet has all of the desired characteristics; consequently, the development of those materials for high temperature use represents a series of closely balanced compromises of property values, such as strength



13 ELECTRIC FURNACE output is climbing fast. This 200-tonner is one of world's largest.

14 COKE OVEN BATTERY at a midwestern plant. Photo shows pusher about to ram out an oven.

15 CONTINUOUS GALVANIZING lines have revolutionized industry, boosted output, quality.

16 TACONITE, processed into pellets for blast furnace use, was first done commercially in 1953.

17 OXYGEN STEEL converter is charged. Photo was made in Austria where process originated.

with toughness, and corrosion resistance with erosion resistance.

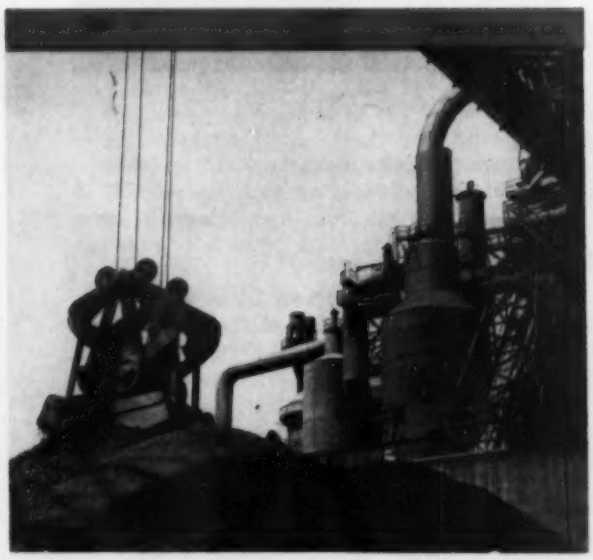
Current applications are generally for the 1500-2000 F range; current thinking is to develop materials for higher temperatures, possibly to 2600 F.

◆ THE CLUSTER MILLS: Carbon steel (C1010) under 0.006 in. thick, 0.001-in. stainless steel (Type 302), and .0005-in. 3 pct silicon iron are some of the products of Sendzimir mills. Reducing 0.010-in. strip stock to 0.0002 in. at speeds up to 300 fpm has been reported; and 0.00015 in. may be attained by one of those mills.

In a typical Sendzimir cold mill, two small work rolls are backed up by clusters of larger rolls of increasing diameter, to permit pressures on the strip of 100,000 to 300,000 psi. Uniformity of strip thickness, crosswise and lengthwise, is a feature of these mills.

The steel industry of the United States now stands in a position unique in its history. It is geared for high capacity operations for domestic demand plus a reserve for defense—a reserve called into play this year to meet a sudden surge of domestic demand. Yet its break even point is lower than ever before.

Four factors contribute to this unusual condition. First is the post-war expenditure (it will top $7.5 billion by the end of 1955) for new facilities and modernization. Second is better knowledge of costs, which goes back to World War II price controls when the industry was obliged to carefully compute its costs. A third is development of new high production, high quality processes. Finally, there is what some call more realistic pricing—no "loss leaders." There has been little senseless price cutting in times of softness—a factor consumers dislike but one which makes steel stocks more attractive to the consumer. Admittedly, this factor has not been fully tested.





IRON AND STEEL...

the future

RESEARCH will continue on some of the problems the industry has inherited from previous generations, such as new methods of hardening steel (which may embrace the entire periodic table of the elements), improving the corrosion resistance of plain carbon steels, and increasing the strength of steels. Increasing the output of existing equipment also is a research objective.

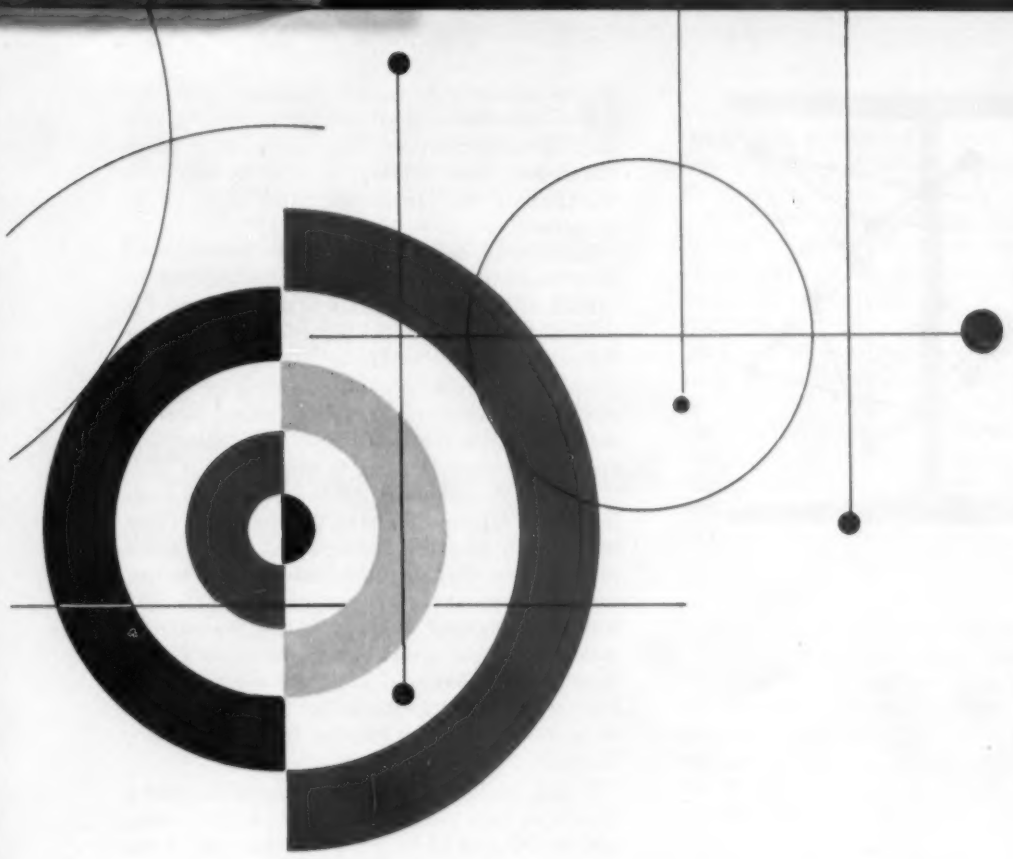
Answers will be sought to basic questions, such as: Why do metals deform plastically? Why do metals resist stress elastically? Why do rate of loading and temperature have such large effects on energy required to break steel?

Accepting the premise that the coke blast furnace continues as the principal source of iron manufacture, the demand for metallurgical coke is assured. In that event, developments in improving coke will depend on improved mining, cleaning, blending and coking; and coke oven development to increase heat conservation is likely. If some other economically available reducing agent is developed, such as hydrogen from "cheap atomic energy," the distillation of coal will probably continue until some cheaper source of the byproduct chemicals is developed. Those chemicals are indispensable in the manufacture of products that maintain the American scale of living.

Future efforts to reduce the ash in coal and coke will pay off: at a net coke rate of 1750 lb coke per ton of pig iron, one per cent increase in ash means an increase of 55 lb of coke per ton of iron.

While the problem of taconite beneficiation is partially solved, research on this development will continue for many years.

From 1941 through 1954 the production of crude steel in the United States totaled about 1,240,000,000 tons. That unparalleled output so depleted U. S. high grade iron ore that ore from every continent except Antartica and Australia is smelted in American blast furnaces or charged into openhearths.



In 1942 research was intensified to develop processes to beneficiate iron minerals in low grade deposits. A pilot plant at Aurora, Minnesota, was set up in 1948 to produce 200,000 tons of taconite concentrates a year. Other plants built or building near Aurora, Babbitt, Beaver Bay, Mountain Iron and Virginia, Minnesota, and Ishpeming and Humboldt, Michigan, are designed for future production of 21,400,000 tons of concentrates annually.

The most extensive U. S. low grade iron deposits are the taconites in Minnesota, which are estimated to contain 27 billion tons, much with an iron content of 30 to 35 pct. These deposits are too lean for direct smelting in the blast furnace.

Magnetite Has Best Outlook

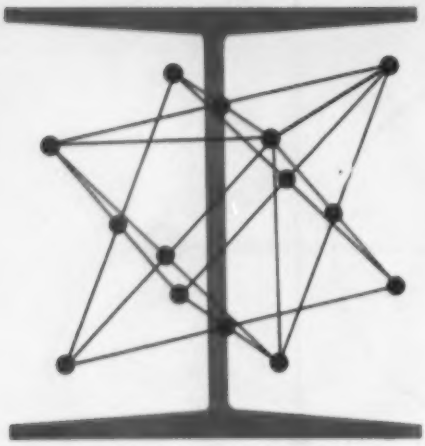
The development of methods for concentrating the taconites was complicated by the need to grind the hard dense ore to the fineness of flour to permit separation and removal of iron minerals. Following that grinding, three types of mineral separation were studied: (1) Removal of particles of the mineral magnetite by magnets; (2) removal of nonmagnetic iron minerals by flotation; and (3) heating the nonmagnetic minerals under carefully controlled conditions to make them magnetic, and removing them by magnets. By 1953, experience with the first type was adequate to warrant construction of large scale concentrating plants.

In 1953 about 120,500,000 tons of iron ore were consumed by United States blast furnaces and steelmaking furnaces, of which about 9,500,000 tons were imported. It is estimated that annual imports of ore will climb to 65,000,000 tons by 1975. But actual imports may be less if economically practicable methods of concentrating hematite in taconite now being studied are developed.

Ore will be sized. Sizing of ore is likely to become standard practice in blast furnace operation as an additional means of increasing iron output and decreasing coke and flux consumption.

Recently reported experiments on sized ore and nodules indicates an increase in iron output of 13.6 pct, a decrease in coke rate of 9.3 pct and a decrease in flux rate of 20 pct, in contrast with a furnace using unsized ore.

Sizing that eliminates fines and large lumps provides a uniform size distribution that is believed to account for the decreased coke consumption. Also, removal of fines eliminates or reduces hanging or channeling; and large



lumps can reach the melting zone insufficiently heated and incompletely reduced.

Sizing may also be obtained by using pellets prepared from beneficiated ores. Other advantages of pellets appear to be more efficient gas-solid heat transfer (total porosity of pellets, sinter and nodules is about 28, 17 and 9 pct, respectively), and therefore a faster rate of reducibility.

In the foreseeable future, the blast furnace is likely to continue to be the principal source of iron. Improvements in design, to accommodate burdens that produce less slag, new or improved refractories to increase campaigns, top pressure and 100 pct sizing of burdens also are likely.

The degree to which design improvements are made in the acid bessemer converter will probably depend more on economics than technology: on the demand for steels low in nitrogen and phosphorus rather than the technology of producing those steels. If that demand is sufficiently great, the use of a basic lining and modification of existing methods of getting oxygen into the molten iron are possibilities. A substantial factor in the success of such modification may be the cost of controlling or recovering fumes from the process.

The immediate future of the basic openhearth also appears to be one of economics rather than technology. So long as scrap is plentiful, the openhearth will continue until a cheaper method is developed to utilize scrap in steelmaking. Development of faster methods of charging, melting and refining will continue; so will the search for better refractories, temperature measurement and instrumentation.

The basic arc furnace will continue to be the primary production unit for steels containing over 5 pct of alloying elements; its future for carbon steels appears to be mainly one of economics, except for carbon steels having special property requirements. As with the future of the openhearth, faster charging (with improved removable tops), faster melting (probably in oval hearths with more than three electrodes), and refining, as well as improved refractories and instrumentation are to be expected.

Continuous casting will grow. Development work continues on the continuous casting of carbon steels and stainless steels because the potential economies are significant: obviating the need for ingot molds, cranes to strip molds from ingots, soaking pits, blooming mills and conveying equipment required when steel is teemed into conventional molds; and billet and slab yields over 95 pct.

Current development methods employ a casting tower topped by a reservoir of metal (protected by a prepared atmosphere) which pours through a tundish or funnel into a water-cooled casting mold onto the end of a dummy bar which is engaged by rolls below the casting mold. Solidified metal leaves the mold as the dummy bar is lowered at a rate controlled by two sets of withdrawing rolls. Below the lower set a torch cuts the casting into appropriate lengths.

Round, oval, square and rectangular sections have been cast. Casting speeds of 60 in. a minute for sections up to 5½ in. in diameter have been attained.

Immediate objectives include casting speeds of 120 in. a minute for sections up to 150 sq. in. and production of 20 tons an hr. Future progress may depend upon the development of faster transfer of heat from the shell of the casting and the interior molten metal, and further development of multiple casting equipment to cast two or more sections simultaneously.

Vacuum Steel a Major Step

Vacuum melting, degasification, pouring and solidification of steel is on its way to a major development in providing steels with property values not hitherto readily attainable and also greater yields of finished products.

Available experience reveals marked improvement in fatigue strength and strength at elevated temperatures, along with greater ductility and hot workability of the steels.

The largest vacuum furnace pours six 1000-lb heats in an 18-hr run. Estimated cost of that furnace is $250,000. Results from that furnace suggest 5-ton heats as the next size.

Vacuumed SAE 52100 for ball bearings has 125,000 psi fatigue strength, compared with 85,000 psi for the air melted steel.

In Germany, conventionally melted steel has been cast in vacuum tanks to provide ingots up to 150 tons for forging power plant inductor shafts and turbine rotors. Vacuum casting obviated the need for extremely slow cooling to release hydrogen.

The vacuum (0.0001 mm of mercury) can be

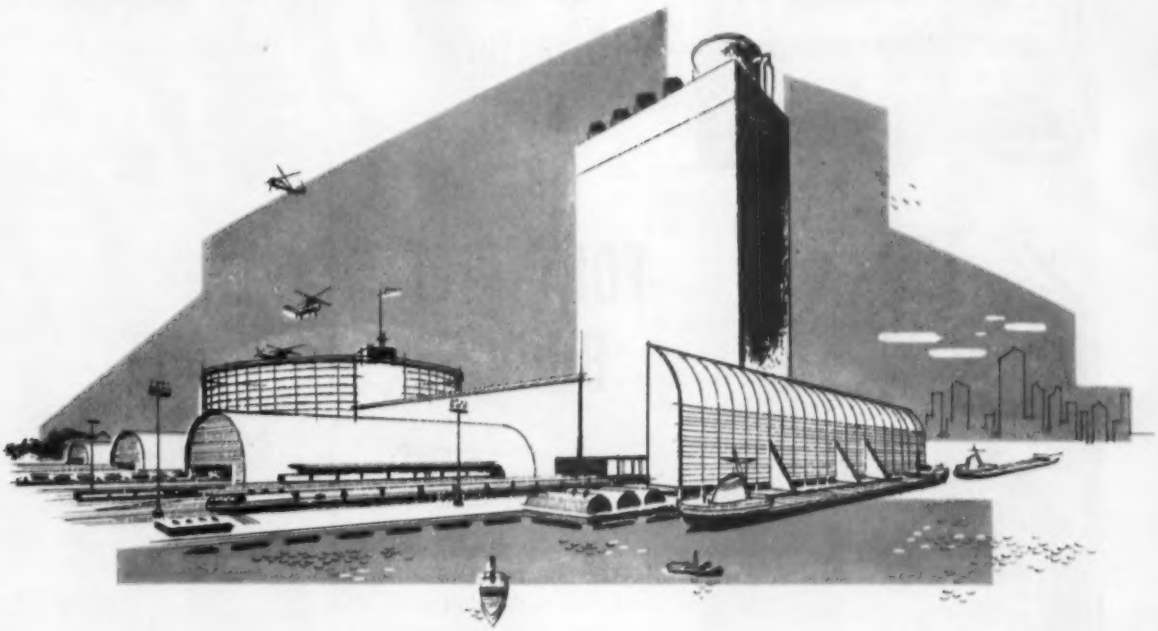
maintained in an induction furnace to produce metals and alloys of an estimated purity of 99.99 pct, and in arc furnaces, having a consumable electrode of the material to be melted, of 99.999 pct.

Stronger, cleaner and nearly gasless steels appear to be only the initial results of research on vacuumed steels. Vacuuming may develop the properties of steel over a wide temperature range. In addition, a long step has been taken forward to answer the question, How strong is steel? So far, our only reply is, We don't know because it always fails at its weakest point!

We're wasting heat. Conservation of energy in every form will get more attention in the future. As a problem in heat conservation it may be interesting to speculate on the following possible sequences of ironmaking and steelmaking, all at elevated temperatures until the final cross section of the end product is attained: (1) Iron from flotation beneficiated taconite reduced by hydrogen (obtained with the aid of "cheap atomic energy"); (2) steel from iron in vacuum electric furnace; (3) continuously vacuum cast "billet" or "bloom" subsequently coated with slag; (4) bar or tube hot extruded from coated casting. Some of the older readers may recall the time when such speculation would give industrialists and bankers a nightmare. However, the climate for technical speculation is good today, and will be even better in the future because the frontiers of science ever beckon to free and informed people.

Statistical methods that are based on probability mathematics provide powerful tools for the economical control of variability in processes and products and in the planning of research and evaluation of research results. The use of those methods is rapidly expanding in the steel industry.

Statistical methods, aided by electronic machines for handling the mathematics and associated clerical drudgery, are very likely to be used on many problems of variability that hitherto were not susceptible to direct attack, such as, for example, burdening the blast furnace, and determining the optimum schedules for charging, firing and pushing coke ovens, as well as the problems of variability that arise from change of raw materials and manufacturing methods on product properties. These methods may also curtail extensively the time required for research and development.



STEEL MILL OF FUTURE will carry integration and automation to new heights. Here high speed units empty vessels of taconite pellets, imported ore and other raw materials for immediate use or to storage area in rear. Casting may well be a continuous operation with trough running from building in foreground back to various finishing mills. Radioactive tracers will separate and identify "heats." Each mill has its own truck and rail loading facilities, all use common water loading area, foreground. Observers, inspectors, etc., will ride on conveyors. Circular office building, rear, has heliport on roof.

SPEED DELIVERY...
REDUCE COSTS...
BUILD BETTER...





with

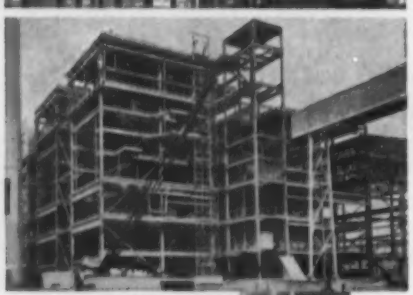
Fabricated Structural Steel

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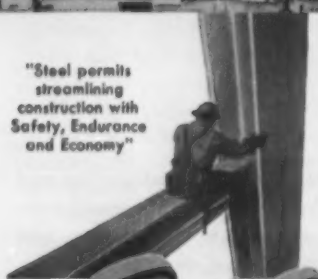
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Quotes: 1855 — 1955

Abstracts from past issues of THE IRON AGE, *selected for their flavor, and with some regard for whimsy:*

Suggest Chromeisen Use In Making Steel

Experiments prove that by using chromeisen instead of spiegeleisen, extremely soft steel is obtained; rods made for experiments were very easily bent, even by hand. It is seen from these attempts to replace spiegeleisen by chromeisen that the use of the chrome-iron alloys is limited, and the steel obtained is for most purposes too soft for the manufacture of such materials as rails, axles, tires, etc.

Strange Phenomenon

According to Chemical News, during some experiments with the chrome-iron alloys, a strange phenomenon was observed. It is well known that chromium is extremely hard and scratches even hardened steel. Meanwhile an alloy was obtained which was malleable, and in a fresh state could be easily bent. The above mentioned alloy was analyzed, and the following average composition was found: Metallic iron, 96.40 pct; metallic chromium, 2.30 pct; carbon, traces; lime, silica, 1.30 pct. By melting a mixture of cast iron, tin and lead in the following proportions, a very liquid alloy is obtained: Cast iron, 79 pct; tin, 19.50 pct; lead, 1.50 pct.

Apr. 6, 1876

Why Not Steel?

A company is being organized in Allegheny to manufacture iron ties. Why iron? In this stage in the development of metallurgy, steel should be the metal.

Mar. 12, 1885

MORE STRIP COMES OUT... LESS COST GOES IN



WHEN YOU put Texaco to work in your mill, you get not only the finest steel mill lubricants but Texaco know-how to use them to best advantage. Here, for example, are two products that Texaco Lubrication Engineers especially recommend for steel mill service—products that more than "pay their way" by their ability to assure trouble-free operation and low maintenance costs:

1. Texaco Meropa Lubricant for enclosed reduction gears. It maintains its notable "extreme pressure" properties under the severest conditions—assuring longer lasting protection.

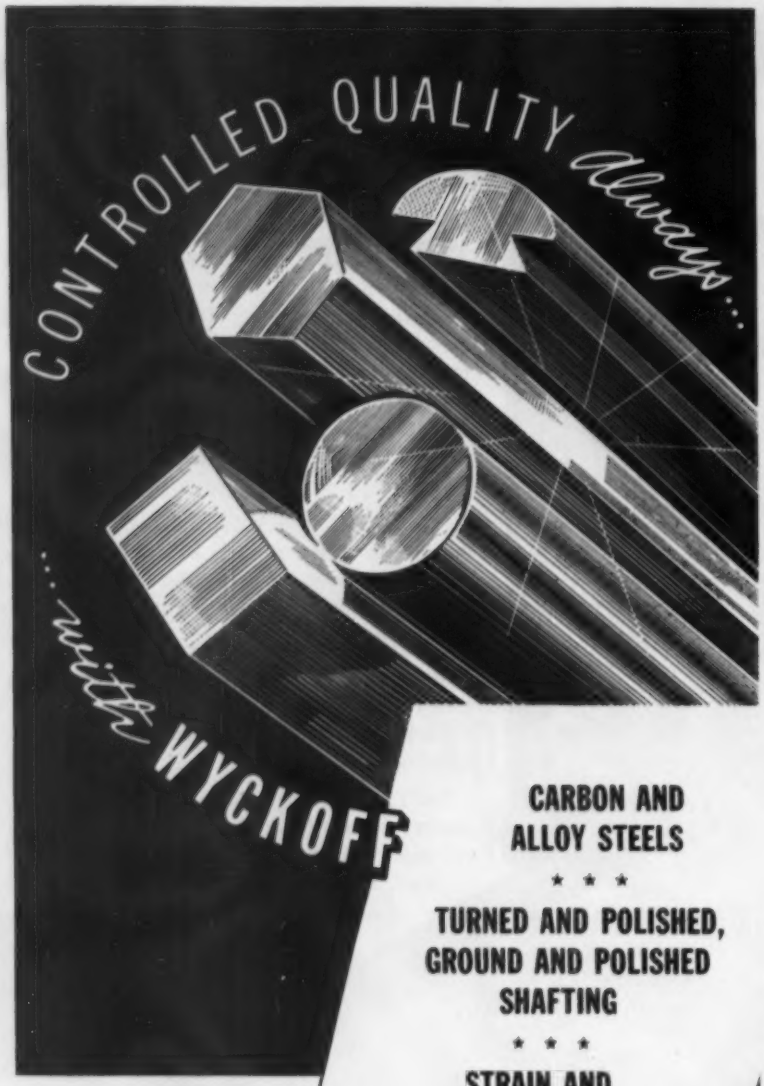
2. Texaco Regal Oil for circulating systems. This turbine-quality oil has outstanding resistance to emulsification, oxidation and sludging, assures full protection for the bearings of backup rolls.

Let Texaco Lubricants and Lubrication Engineering Service help keep your production up and unit costs down. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

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CARBON AND ALLOY STEELS

★ ★ ★

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Boiler Factory Busy

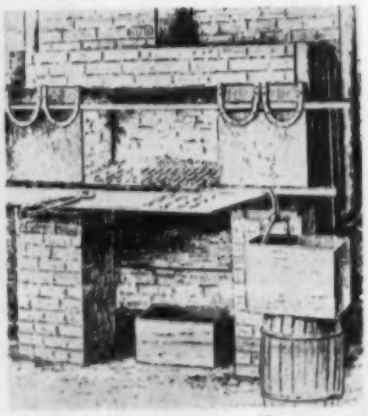
The Holyoke (Mass.) Steam Boiler Works recently shipped a 9 ton bleacher, 22 feet long, to a San Francisco paper mill, by way of Cape Horn. They are at work on three 80 horsepower boilers for the lunatic asylum at Northhampton, and will soon finish two of 60 horsepower each for Hayden & Gere. They are now running about 25 hands.

June 17, 1875

Tennessee Steel

The experiment of making steel at Kingston has been thus far entirely successful. It is made from pig iron direct into puddled steel, and then refined in crucibles, under a patent granted Mr. John Leighton by the United States government. The result thus far has been a production that is spoken of in the highest terms by the manufacturers of cutlery. The capacity of the works is now but about 1000 pounds per day, but the whole thing is in the hands of some of the wealthiest men of East Tennessee, who are simply biding their time to develop it to a first-class manufacturing establishment.

July 6, 1876



The Iron Age

TEMPERING FURNACE of 1860's, coal fired, with quench tank beneath.



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Carbon and alloy steels, hot rolled or cold drawn, for mechanical and pressure applications. Size Range: Approx. ¼" O.D. x 22 Ga. to 7" O.D. with walls proportioned to diameter.

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Meets exacting AMS, Army and Navy specifications for Aircraft Mechanical Tubing.

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Shelby, Ohio—Birthplace of the seamless tube industry in America

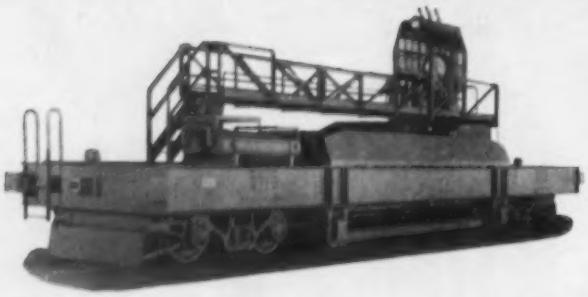
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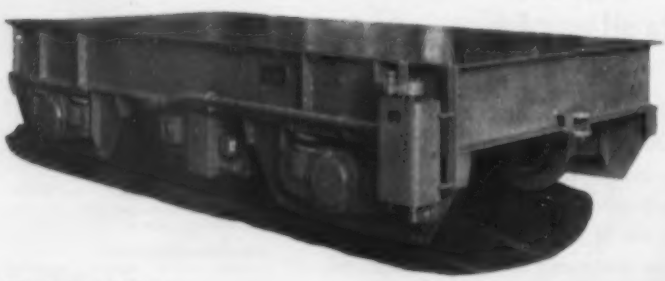
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QUOTES: 1855—1955

Wire Rope Maker

At the extensive works of John A. Roebling's Sons Co., manufacturers of iron and steel wire rope, at Trenton, between 600 and 700 hands are employed. The works are now running on full time, the product being at the rate of 5000 tons per annum. The finest grades of wire are made from Swedish iron mixed with scrap.

Mar. 11, 1880

Out for Repairs

The Durham Furnace, at Riegelsville, has gone out of blast. The difficulty was caused some time since by the breaking of one of the engines, which required two weeks to repair. During this time the furnace was run with one engine, and not being driven to her capacity, a scaffold was formed, from the effects of which she has never recovered, although at times since then she has worked exceedingly well, making as high as 450 tons per week. Prior to this mishap she was making upward of 500 tons weekly, and on a single day she made 83 gross tons. We understand that she will be started again as soon as the proper repairs are made.

Apr. 15, 1880



Bettman Archive

WIREMAKING in 1873. Here the core is being covered with wire.

BUILDS EXTRA SELLING POWER INTO YOUR PRODUCTS



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the IronAge

Your century of service—like the recent opening of our new cold mill—represents achievement...to the industry ... to the nation. You saw and reported the last hundred years of ALAN WOOD progress . . . you chronicled the evolution of iron and steel to a precise science. Congratulations . . . and may you continue another hundred years of excellent services . . . another century in which steel consumers and the nation will benefit from further ALAN WOOD advances in research, development and production of iron and steel products.

IRON PRODUCTS
"Swede" *pig iron*
STEEL PRODUCTS
Plates (sheared)
Hot rolled sheets
Hot rolled strip
Cold rolled sheets
Cold rolled strip
ROLLED STEEL FLOOR PLATE
A.W. ALGRIP *abrasive*
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SM-13

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Better steels are the result of many things, not the least of which are addition agents. Although they may be small quantitatively, additives are extremely important qualitatively.

For many years, Foote Mineral Company has aided steel makers in materially improving both the quality of finished steel and the intermediate conditions involved in producing it. Manganese Sulphide and Rimex are two steel additives developed by Foote. Manganese Sulphide provides a more practical and economical means of introducing manganese and sulphur into free-machining steels. Rimex, by producing a more vigorous rimming action, improves the quality of rim steels while reducing production costs.

Foote's highly specialized metallurgical engineering group is eager to work with steel producers to find means to improve both the economics and characteristics of metals for industry.

Write for information. Product data sheets will be sent upon request.



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The Iron Industries of Wisconsin

A correspondent, writing from Milwaukee, sends us the following interesting information respecting the furnaces of Wisconsin, with an estimate of the iron production of the State. The furnaces of the Milwaukee Iron Co., at Milwaukee, Wisconsin, use a fuel consisting of one half coke and one half anthracite coal. The ore employed consists of three-fifths Iron Ridge ore and two-fifths Lake Superior ore. The production of furnace No. 1 for 1872 has been 16,000 tons of pig iron; furnace No. 2, 17,000 tons. The furnace of the Northwestern Iron Co., at Mayville, Wisconsin, using charcoal as a fuel, and Iron Ridge ore, has produced, in 1872, 3000 tons of pig iron. The furnace of the Wisconsin Iron Co., at Iron Ridge, uses charcoal and Iron Ridge ore, and produced 3300 tons of iron. The furnace of J. F. Smith, at Ironton, in Sauk county, Wisconsin, uses charcoal and Sauk county ore, and produced 1300 tons of pig iron. The furnace of the National Iron Co., at Depere, Wisconsin, uses charcoal and Lake Superior ore; yield in 1872, 6500 tons. The furnace of the Fox River Iron Co., at Depere, uses charcoal and Lake Superior ore; its yield in 1872 was 7000 tons. The furnace of the Green Bay Iron Co., at Green Bay, Wis., uses charcoal and Lake Superior ore, and produced 6000 tons. The furnace of the Appleton Iron Co., at Appleton, Wis., uses charcoal and Lake Superior ore, and produced 6500 tons of iron.

The total production in Wisconsin in 1872 has been therefore about 67,600 tons. The probable increase of production in 1873 will be about as follows. The Minerva Furnace Co. is building a fifteen feet furnace in Milwaukee, to use half coke and half coal fuel, and

Turn to page D-30



It was true a hundred years ago



. . . and it's even
more true today


The Smith

A Mighty Man Is He...

Not too long ago as the clock ticks, transportation was kept flowing and industry and commerce were kept alive by the glowing forge, the ringing anvil and the mighty muscles of the village blacksmith. He was the original heat treater, forger, metal fabricator. The horseshoes, wagon axles, plow shares and other essential products that came from his humble shop were indispensable to the life of his community.

The village blacksmith has his modern counterpart in the heat treater, the forger, the metal fabricator of today.

The little shop down the street under the spreading chestnut tree has given way to the great plant down the highway near the sprawling cloverleaf, and the musical ring of the anvil has become the thundering roar of heavy metal working equipment, the hiss of the welding torch, and the rat-tat-tat of the riveting hammer.

All around us is proof, indeed, that in our modern way of life the metal fabricator is still the indispensable man. From his labors come the rails, the trains, the planes, the automobiles, the bridges, the skyscrapers, the farm machinery, the household appliances, the countless other products that have made our high standard of living possible.

During the past hundred years the metal fabricator and United States Steel have progressed hand in hand. Just as the blacksmith modernized his equipment and extended his operations, so have we improved our techniques and facilities, developed new and better products to give his successor ever-better service. While the blacksmith's suppliers provided him with only a few different grades of iron and steel bars to meet his simple needs, United States Steel today supplies the metal fabricator with hundreds of grades, forms and sizes of steel for every conceivable product and application.

Today in our many research laboratories and steel mills, more efficient and more versatile steels and steel products are constantly being perfected. Faster and more economical methods of applying steels are being discovered. New uses for steel hitherto not even contemplated are being turned up and found practical.

Thus the metal fabricator, now and in the future, can confidently rely on steel to help him obtain whatever qualities his product needs to make it more durable, better in performance, less costly to manufacture, and easier to sell. For as one hundred years experience have shown—*only steel can do so many jobs so well.*



USS TRADE MARK

On the following page are shown the steel producing and merchandising divisions and subsidiaries of United States Steel, with a very brief list of the principal products made by each. If you have a problem involving the use of any USS product, write, wire or phone your nearest USS Sales Office. You will find the largest staff of research, metallurgical, and engineering personnel in the entire steel industry eager to help you, without obligation.

For STEEL and STEEL PRODUCTS

that meet today's needs and anticipate tomorrow's

UNITED STATES STEEL CORPORATION

General Offices: 525 William Penn Place, Pittsburgh 30, Pa.—Manufacturers of ingots, blooms, billets and slabs; bars; plate; sheet and strip; tin plate; sketch plates and structural shapes; CB sections; bearing piles and steel sheet piling; floor plate; wheels, rails and track materials; special trackwork and accessories; mine and industrial cars; commercial forgings for heavy machinery of all types; liner plates and grinding balls; Lorig Aligner rolls and pulleys; USS Stainless and Heat Resisting Steels; USS Carilloy Alloy Steels; USS T-1 Constructional Alloy Steel; USS High Strength Steels.

AMERICAN STEEL & WIRE DIVISION

General Offices: Rockefeller Building, Cleveland 13, Ohio—Manufacturers of Wire and Wire Products—wire fencing, barbed wire, baling wire, steel posts, wire rope; aircraft control cables; rail bonds and signal bonds; telephone wire and strand; electrical wires and cables; cold rolled strip; springs and spring wire; manufacturers wires; highway guards; concrete reinforcement; nails, tacks and staples. USS Stainless and Heat Resisting cold rolled strip, wire and wire products and USS High Strength Steel products.

CYCLONE FENCE DEPARTMENT — General Offices: Waukegan, Ill.—Manufacturers of chain link and lawn fencing; fence gates and posts; wire partition work; wire baskets; chain link and flat wire belting; wire screen cloth, wire hardware cloth.

NATIONAL TUBE DIVISION

General Offices: 525 William Penn Place, Pittsburgh 30, Pa.—Manufacturers of seamless and welded wrought tubular products (in plain, carbon and in all alloy steels applicable to pipe and tubing); standard, extra strong and double extra strong pipe; boiler and superheater tubes; still tubes; condenser and heat exchanger tubes; drill pipe, casing, tubing, drive pipe, line pipe; large OD pipe; pipe piling; line poles, flag poles, mast and booms; cylinders, gas bottles, miscellaneous pressure containers; mechanical tubing, aircraft tubing, alloy tubing; miscellaneous tubular forgings. USS Stainless Steel pipe and tubes. Also plastic (polyethylene) pipe.

TENNESSEE COAL & IRON DIVISION

General Offices: P. O. Box 579, Fairfield, Ala.—Manufacturers of semi-finished steel; structural shapes; sheared and universal plates; merchant bars, concrete bars; hot and cold rolled sheets; flat and formed galvanized sheets; strip; cotton ties; tin mill products; rails, axles and track materials; forgings and castings; wire, wire rods, woven fence, barbed wire, bale ties; nails and staples. Southern distributors of products of other manufacturing divisions of United States Steel.

COLUMBIA-GENEVA STEEL DIVISION

General Offices: Russ Building, San Francisco 6, Calif.—Manufacturers of iron and semi-finished steel; billets, structural shapes; sheared plates; hot rolled bars, sheet and strip; cold reduced sheets; galvanized sheets; tin plate and tin mill products; wire rods; high and low carbon wire; bright and galvanized wire; wire rope and strand; barbed wire and fence; baling wire; nails and staples. Western distributors of products of other manufacturing divisions of United States Steel.

U.S. STEEL SUPPLY DIVISION

General Offices: 208 So. La Salle Street, Chicago 4, Ill.—Operates warehouses from coast-to-coast, carries in stock for immediate shipment hundreds of varieties and sizes of steel and steel products. Material is available in standard warehouse lengths and sizes, or can be cut to customer requirements.

UNITED STATES STEEL EXPORT COMPANY

General Offices: 30 Church Street, New York 8, N. Y.—Export distributor for all steels and steel products manufactured by United States Steel.

Printed in U.S.A



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You always *pay* for the best when you buy flat spring steel... make sure you *get* it by specifying Roebling. John A. Roebling's Sons Corporation, Trenton 2, N. J.

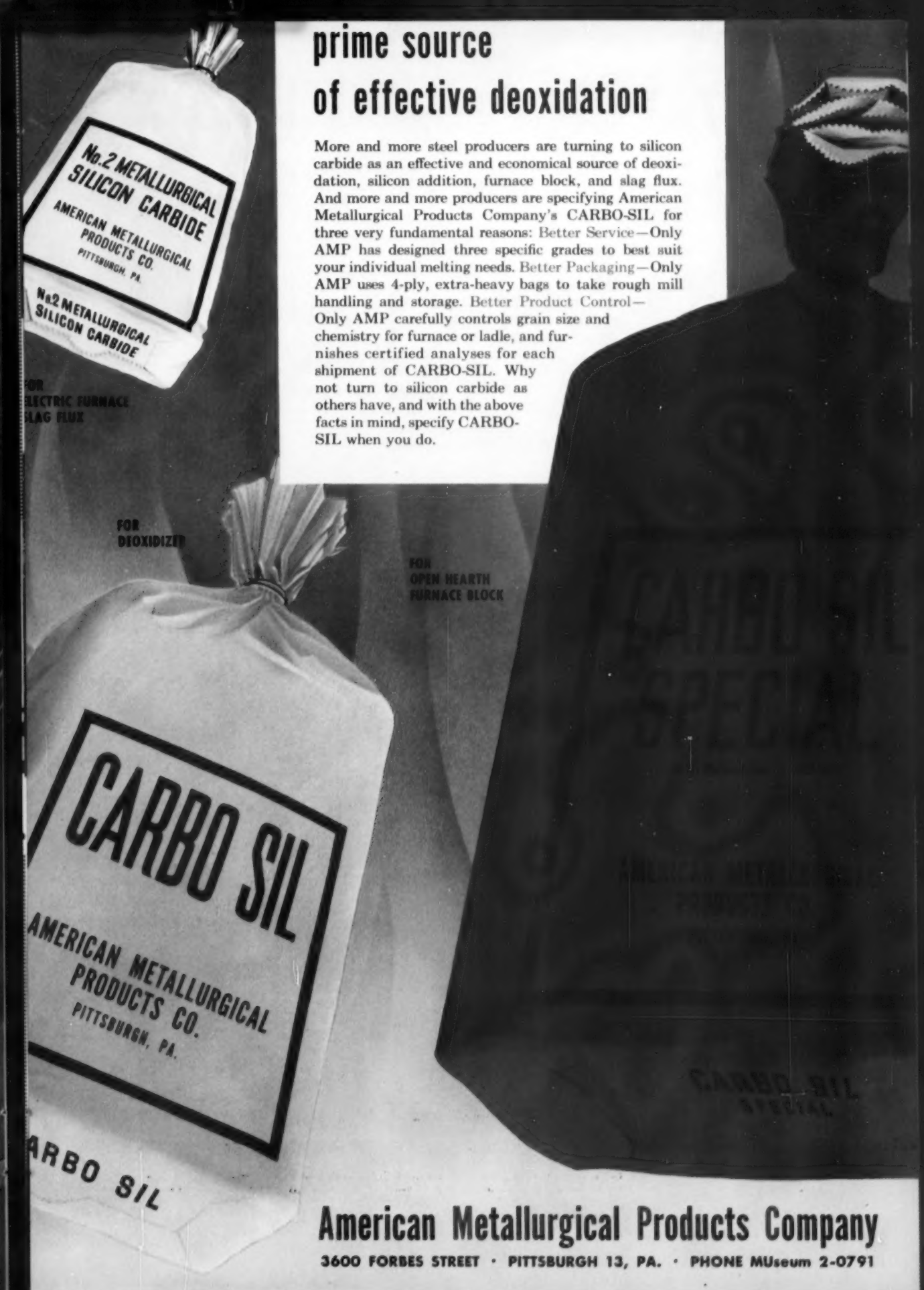
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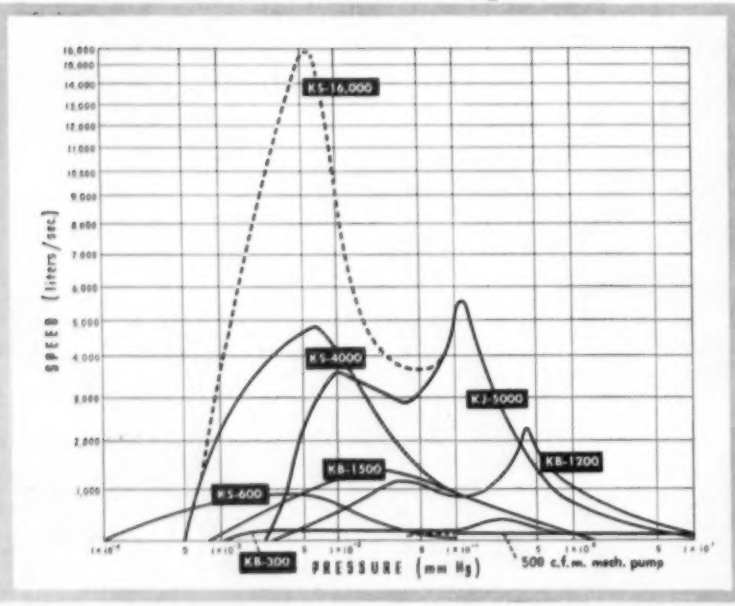
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These CVC pumps... are working in these vacuum metallurgy installations

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KS-600	5-50 lb. Melting and Casting
KB-1200	1000 lb. Consumable Electrode Arc Melting
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KJ-5000	1000 lb. Melting and Casting at 3 to 25 microns pressure
KS-16,000	1000 lb. Melting and Casting at 0.8 to 15 microns pressure

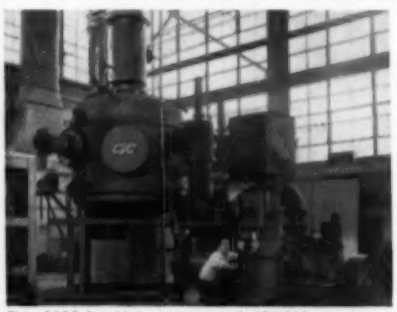
and here's *how* they work



If you work or plan to work in vacuum metallurgy, you can profit by *CVC's* practical experience in the field.

CVC is currently designing, building and installing high vacuum furnaces which solve many unusual problems. The wide range of pumps used in these installations and the know-how we have obtained from our work with them can go far in helping to solve your problems.

We welcome the opportunity to discuss high vacuum metallurgy with you. For further information and a copy of our "Information Memo" on High Vacuum Metallurgy write to ***Consolidated Vacuum Corporation, Rochester 3, N. Y.*** (a subsidiary of Consolidated Engineering Corporation, Pasadena, California).



This 1000-lb. high vacuum melting and casting furnace is an example of efficient, economical design. The buyer is starting with 350-lb. melts. The 4800 liters-per-sec. speed of a single KS-4000 pump is more than adequate for 350-lb. melts (see graph). When he's ready for 1000-lb. melts, he simply adds another KS-4000 pump and a 1000-lb. coil and crucible.

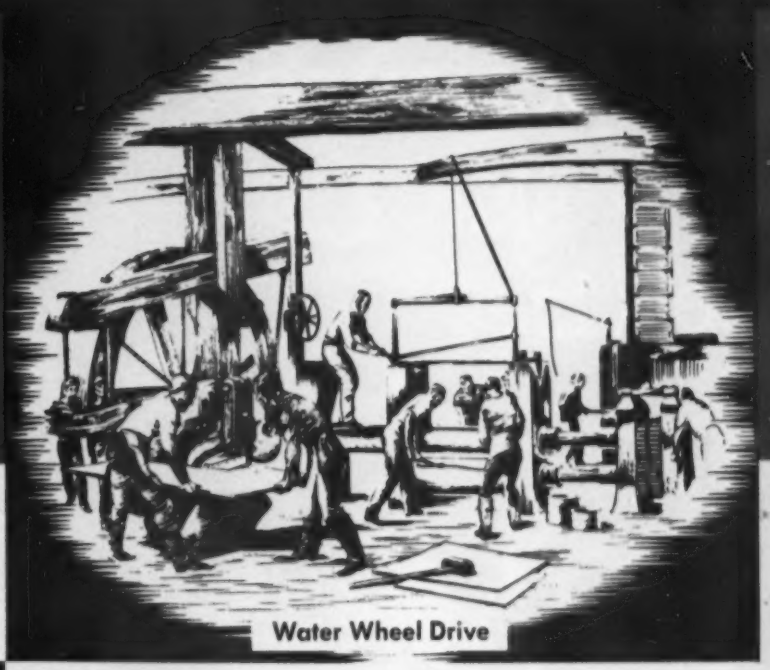
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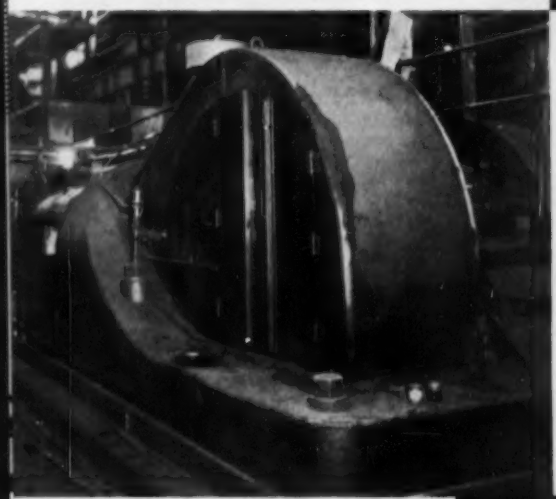
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Water Wheel Drive

A forerunner of Lukens Steel Co., present day 209" Plate Mill, driven by a 100 HP water wheel powered from Brandywine Creek, operated from 1818 until 1870.



Engine Drive

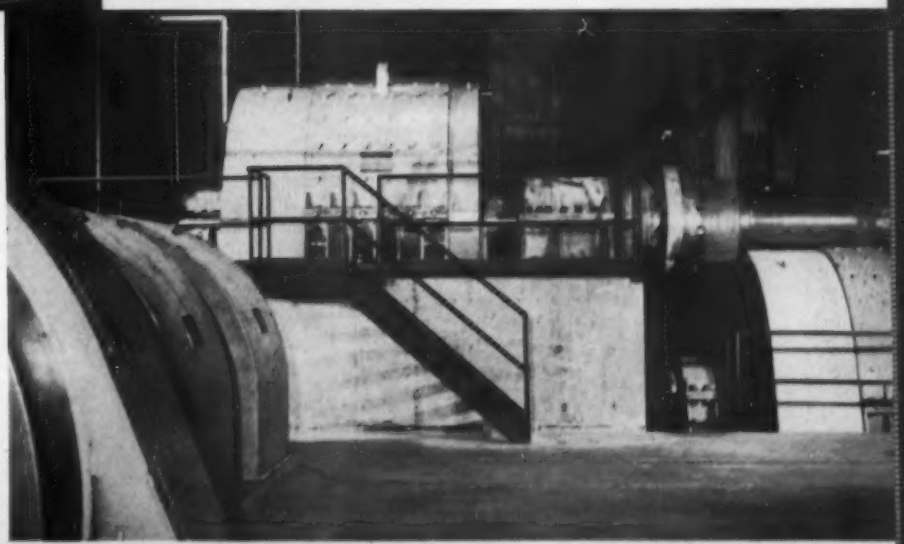
Jimmy Watt's version of the steam engine entered the power field around 1800 and even before 1855 had become generally accepted as the preferred source of power for rolling steel.

Though destined for replacement by the electric motor, the steam engine proved to be a stubborn competitor and even today some 24 mills are still so powered.

This 3000 HP steam engine drive rolled steel for Whitaker-Glessner Co. and its successors from 1914 until replaced in 1950 by this 8000 HP twin motor drive on a new Blooming-Slabbing Mill for Detroit Steel Corporation at their Portsmouth Ohio plant.

PEC mill installations since 1946 have sent eight of the old timers to the scrap pile. If your company contemplates the replacement of an engine drive or an outmoded mill perhaps the experience we have thus gained would prove useful in your construction program.

Write for illustrated booklet.



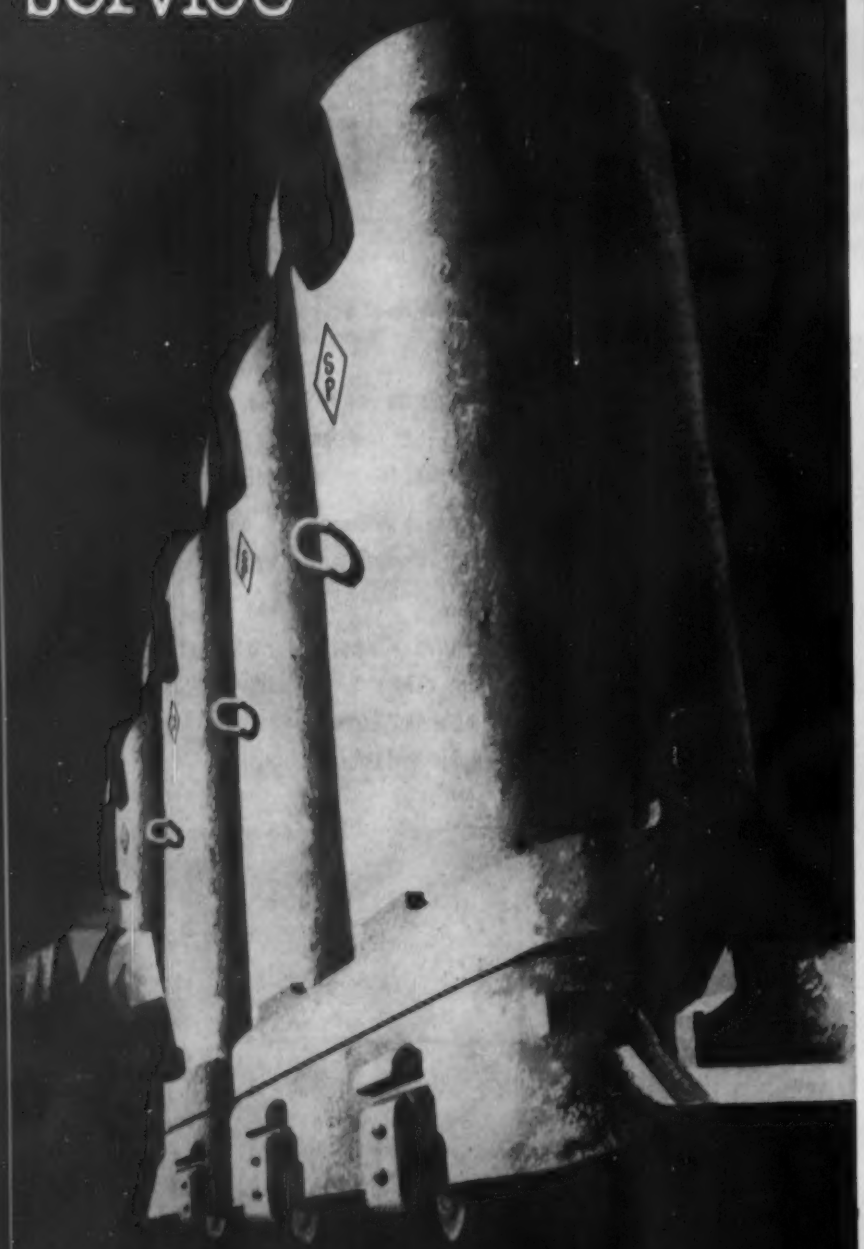
Motor Drive

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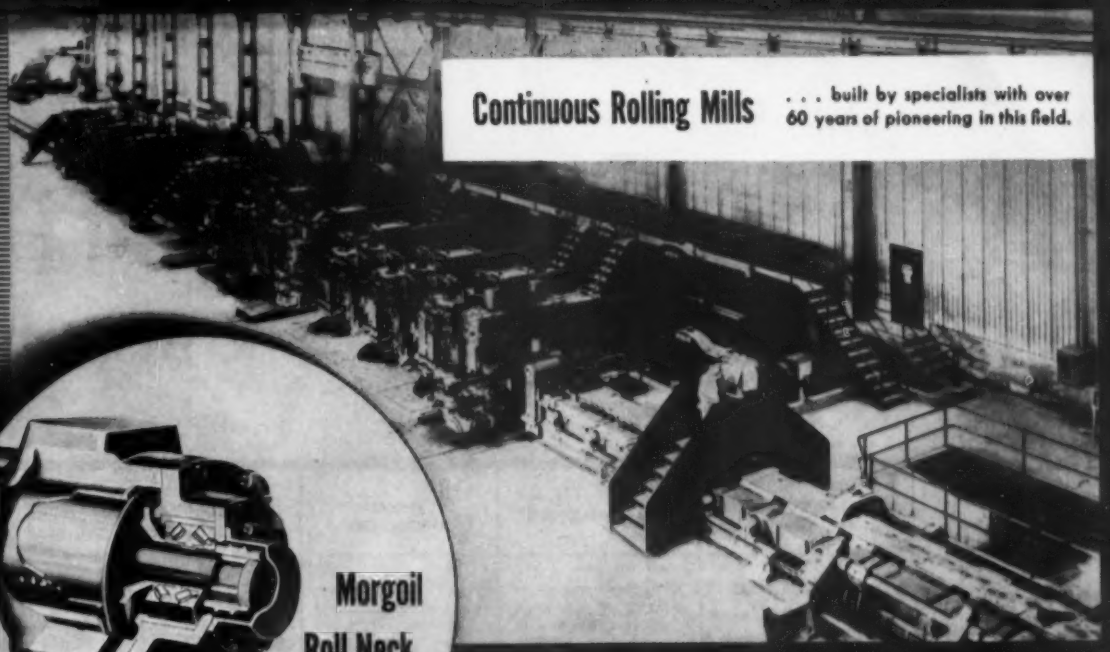
Bettman Archive

STEAM PUDDLER, patented in 1854, as used in 19th century ironmaking.

Iron Ridge and Lake Superior ore. It will go in blast about June 1st 1873, and will make in 1873 about 7000 tons. The Appleton Iron Co. is building a new stack, and will make in 1873 about 6500 tons. The National Iron Co., of Depere, is building a new stack similar to the old, and will make about 5500 tons. The Fox River Iron Co. is building a stack similar to the old one, and is now about ready to blow, and will make in 1873 about 6500 tons. The furnace of the North Western Iron Co. was rebuilt this year and enlarged. In 1873 it will doubtless make 5000 tons. A charcoal furnace is building at Fond du Lac. It will probably go in blast about May or June, and should make in 1873 about 3200 tons. It is consequently safe to say that the increase in the production of pig iron in 1873 in Wisconsin, over 1872, will be about 33,000 tons.

The production of rails by the Milwaukee Iron Co. in 1872 has been about 35,000 gross tons, an increase of about 10,000 gross tons over 1871. The company has a new "top and bottom mill" about completed. This should enable them to make 12,000 tons more in 1873 than they have made in 1872. They expect therefore, to make about 47,000 tons of rails in 1873.

Jan. 2, 1873



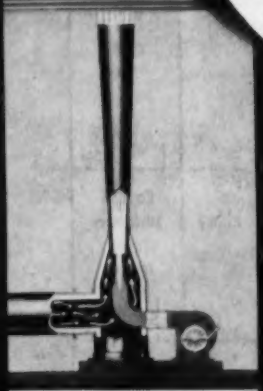
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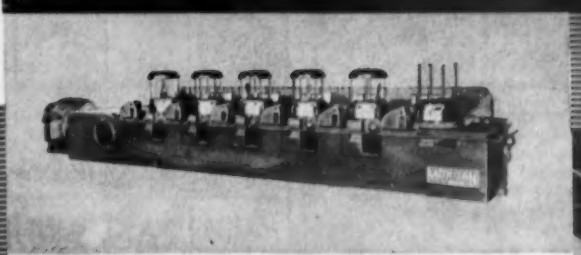
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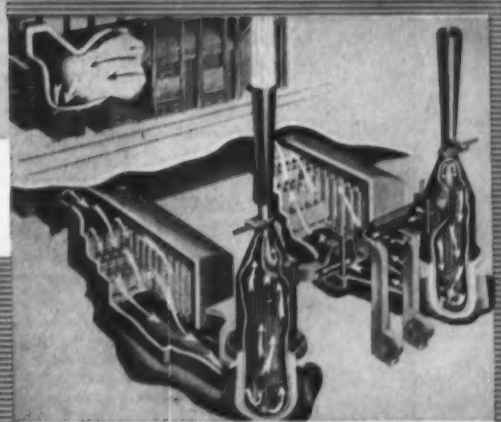


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. efficiently handle hot gases d fumes as high as 3000° F.



Wire Machines . . . Morgan-Connors give high production, with low die cost, low power cost, low space requirement.



Furnace Control System

. . . Morgan-Isley increases efficiency of any regenerative furnace at relatively low installed cost.

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English Representative
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Special Armco

TOP-

	ARMCO® GRADE OR FINISH	CHARACTERISTICS	TYPICAL APPLICATIONS	FABRICATING PROPERTIES				
				Welding	Soldering	Drawing	Forming	Paint Adherence
stainless steels	STAINLESS STEEL 1. sheets, strip, plates 2. bars, wire, angles, special shapes, billets	Rustless metals with an attractive surface, high tensile strength and resistance to heat and corrosion.	Many kinds of industrial, institutional, household and architectural products and equipment.	1. Excellent	Excellent	Excellent	Excellent	Paint not needed
				2. Excellent	Excellent	MACHINING	FORGING	COLD FORMING
						Very Good	Good	Excellent
Armco coated sheet steels	ALUMINIZED STEEL® Type 1	Aluminum-coated steel sheets for resistance to a combination of heat and corrosion.	Auto and truck mufflers, furnace combustion chambers, heat reflector parts in ranges, heaters, toasters and similar equipment.	Good	Cannot Be Soldered	Good	Good	Paint Not Needed
	Type 2	Aluminum-coated steel sheets for excellent resistance to atmospheric corrosion.	Building panels, roofing, roof deck, silo roofs, rolling doors and other products exposed to the atmosphere.	Good		Not Recommended	Good	
	ZINCGRIP®	A special zinc-coated sheet metal with superior coating adherence. Does not flake or pool in severe forming and drawing operations.	For all kinds of drawn or formed products requiring a protective zinc coating. Also supplied in ZINCGRIP PAINTGRIP for immediate painting.	Good	Very Good	Very Good	Very Good	Good if surface is properly treated before painting
	ZINCGRIP PAINTGRIP®	This mill-Bonderized special zinc-coated steel provides a surface that takes and preserves paint without pretreatment of any kind.	For many kinds of architectural work, signs, truck bodies, farm equipment, dispensers, air-conditioning units, metal furniture, and other products.	Good	Good	Very Good	Very Good	Excellent
other Armco products	ELECTRICAL STEELS	Steels that can be magnetized with less expenditure of energy and still possess other necessary properties such as flatness, ease of punching and adequate interlaminar resistance.	There's a grade of Armco Electrical Steel for every need—motors, transformers, generators and electronic equipment.	Excellent Fabricating Properties				
	ENAMELING IRON	A highly refined, uniform iron specially processed for fusing with porcelain enamel under high temperatures (around 1550° F.). Holds porcelain enamel in a lasting bond.	Used in household appliances, formed iron plumbing ware, cooking utensils, signs, buildings, and building construction. Also used in processing equipment.	Excellent		Excellent	Excellent	
	COLD-ROLLED PAINTGRIP®	This special mill-Bonderized sheet metal provides a surface that takes and preserves paint without additional pretreatment.	For signs, dispensers, air-conditioning units, metal furniture, under sink cabinets, kitchen cabinets and hospital equipment.	Very Good	Good	Excellent	Excellent	Excellent
	MECHANICAL TUBING	Standard or special shapes of light-walled mechanical steel tubing for high strength, light weight, low cost. Can be fabricated readily.	Used in all kinds of products where designers can replace heavy solids or castings with light structural sections made of tubing.	BENDING	BEADING	SWAGING	SOLDERING	WELDING
				Very Good	Very Good	Good	Good	Very Good

Steels for your

QUALITY PRODUCTS

You'll Find a Grade for Every Need

For more than half a century, Armco has pioneered in the creation and production of *special* sheet steels. Today, *scores* of special grades are shipped from Armco's mills to manufacturers all over the free world.

In 1905, Armco developed high-silicon steels to reduce power losses in transformers and other electrical equipment. Then came a commercially pure iron known as Armco Ingot Iron. It meant better galvanized sheets and an ideal base for porcelain enamel. Many other special steels like stainless steels, ZINCGRIP and ALUMINIZED followed. They were the result of Armco's research programs to create special steels to help manufacturers make better, longer-lasting products.

But supplying you with special steels like these is only part of the story . . .

Engineering Aids

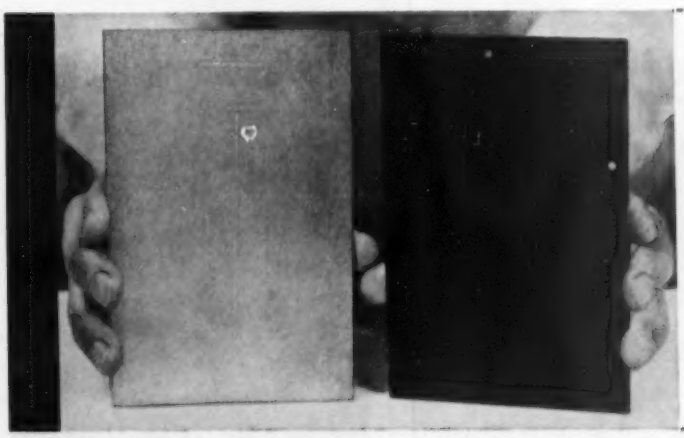
Armco engineers are ready to work with you in solving problems of design, fabrication and construction. In many cases, manufacturers have cut costs and improved their products by redesigning with Armco Stainless Steels or other special grades.

Marketing Help, Too

For many years Armco's national consumer advertising has told the story of Armco Special Steels. The well-known Armco triangle trade-mark is a symbol of better steel—the consumer's assurance that the manufacturer has used a special quality steel to make his product better.

Armco labels, point-of-sale tags, reprints of advertisements and other sales helps are available free to manufacturers who use Armco Special Steels in their products.

Write us for catalogs and complete information on any of the special steels listed on the opposite page. Or just call our nearest sales office.



Armco ALUMINIZED STEEL (Type 2) is one of the newest Armco Special Steels. It is hot-dip aluminum-coated—combines the corrosion resisting properties of aluminum with the strength of steel. It was put into production only after many years of corrosion testing. These tests show the atmospheric corrosion resistance of the aluminum coating is at least 3 times that of a commercial coating on galvanized steel sheets.

In atmosphere sufficiently corrosive to cause a standard galvanized coating (right) to fail completely in 12 years, Armco ALUMINIZED STEEL (Type 2), left, looked like this after 15 years. Cleaned samples show the aluminum coating is still giving full protection to the base metal.

ARMCO STEEL CORPORATION 1325 CURTIS ST., MIDDLETOWN, OHIO

SPECIAL STEELS

SHEFFIELD STEEL DIVISION • ARMCO DRAINAGE & METAL PRODUCTS, INC. • ARMCO INTERNATIONAL CORPORATION

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BRITISH COLUMBIA

Official Sounds Warning

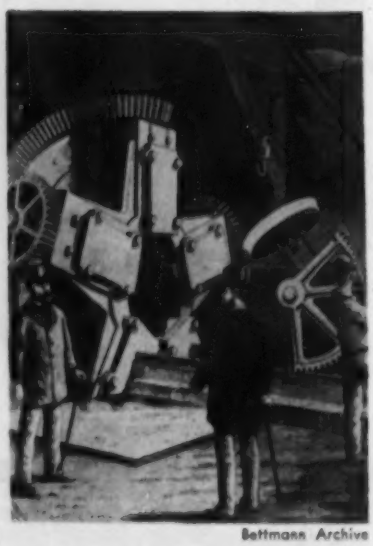
The Secretary of the Treasury, in his last annual report, gave due warning of coming trouble. He said: "Unless the coinage of silver dollars and the issue of silver certificates are suspended there is danger that silver, and not gold, may become our metallic standard."

Feb. 5, 1885

The Hot Stove Era

Cast Iron Stoves—Some experiments which will have great practical utility have just been made in Paris on these pestiferous, fever-generating engines, cast iron stoves. From all these numerous and varied experiments it appears, first, that beside the immediate and serious danger inherent to all metal stoves from their so easily attaining a red heat, cast iron stoves offer the particular drawback of evolving a considerable but variable quantity of oxide of carbon, a highly poisonous gas. Second, that under the same circumstances sheet iron has the same defect, though in a lower de-

Turn to page D-39



Bettmann Archive

ROLLING and compressing steel car wheels, using Fowler process, 1888.



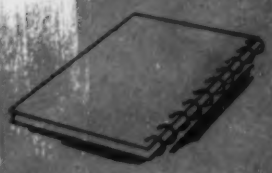
WIRE FOR PAPER CLIPS



PIANO COVERING WIRE

Whatever your problem is in

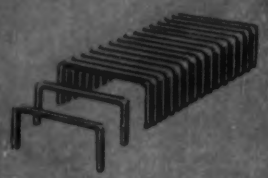
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COIL BINDING WIRE



FLORIST WIRE



PREFORMED STAPLE WIRE



WIRE FOR TOY WHEELS



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WIRE BALES FOR BUCKETS, PAILS, ETC.

Thousands of wire applications in over a half century—involving virtually every kind of a wire problem—that's the experience and background we offer you in solving *your* special wire problems. We can supply wire from almost the size of a human hair, through 9/16" diameter for metal fasteners . . . round wire or wire in special shapes, practically any size, temper, finish and analysis in low carbon and medium low carbon steels. We may have a valuable case history that parallels your own special problem. Fill out and return the coupon for full details of Continental's Wire Service. We are eager to work with you.



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In our 93rd year Pollock salutes Iron Age on its 100th Anniversary

The William B. Pollock Company has been serving the iron and steel industry the world over since 1863.

Pioneers in heavy steel work, Pollock is excellently qualified, equipped and staffed to design and build your special heavy-duty equipment.

Pollock is known for its reliable, efficient precision work. You, too, can benefit from Pollock's broad experience.











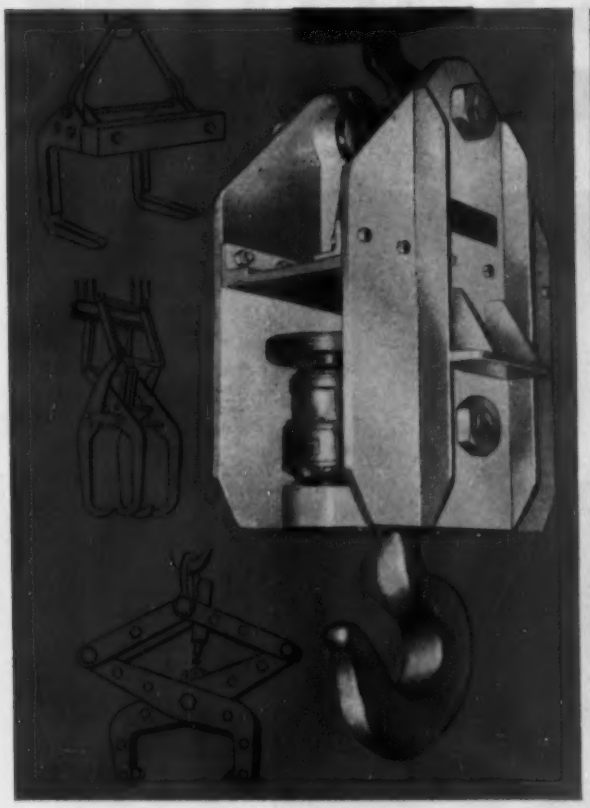


POLLOCK
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STEEL PLATE CONSTRUCTION · ENGINEERS · FABRICATORS · ERECTORS

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To meet industry's highest standards... HEPPENSTALL PRODUCTS

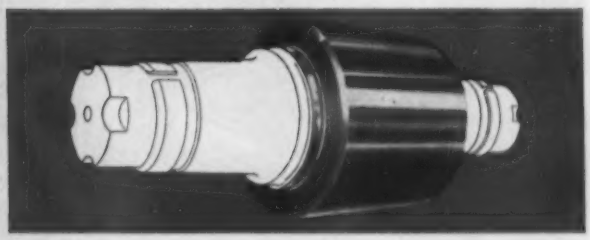




You can KEEP PRODUCTION HIGH... with HARDTEM DIE BLOCKS

Records from plants using Hardtem Die Blocks prove the following benefits for production:

Long life of dies. Less downtime. Lower over-all die cost. Holding of true dimensions. Longer production runs.



You can SPEED LIFTING JOBS... with HEPPENSTALL SAFE-T-TONGS

There's no limit to the range of jobs that Heppenstall Safe-T-Tongs can do. They are engineered specifically to *your* needs. The records of plants using Safe-T-Tongs prove their reputation for: EFFICIENCY . . . ECONOMY . . . SAFETY.

You can REDUCE DOWNTIME with Heppenstall BACK-UP ROLL SLEEVES

Records of many rolling mills show that Heppenstall Sleeves reduce downtime with resulting increase in productivity and lower over-all costs. They're "custom-bilt" to exact specifications. The results: Correct hardness. Maximum density. Exact fit. Durable surfaces. Resistance to cracking and spalling.

HIGH TEMPERATURE ALLOYS

Heppenstall's durable high-temperature alloy steel forgings, rolled rings, and billets for drop forgings are notable developments which demonstrate the company's technical skill in meeting the latest demands of the aircraft industry.

If you have a heat problem involving high-temperature alloys, contact Heppenstall Company—they will be glad to put their knowledge and experience to work for you.

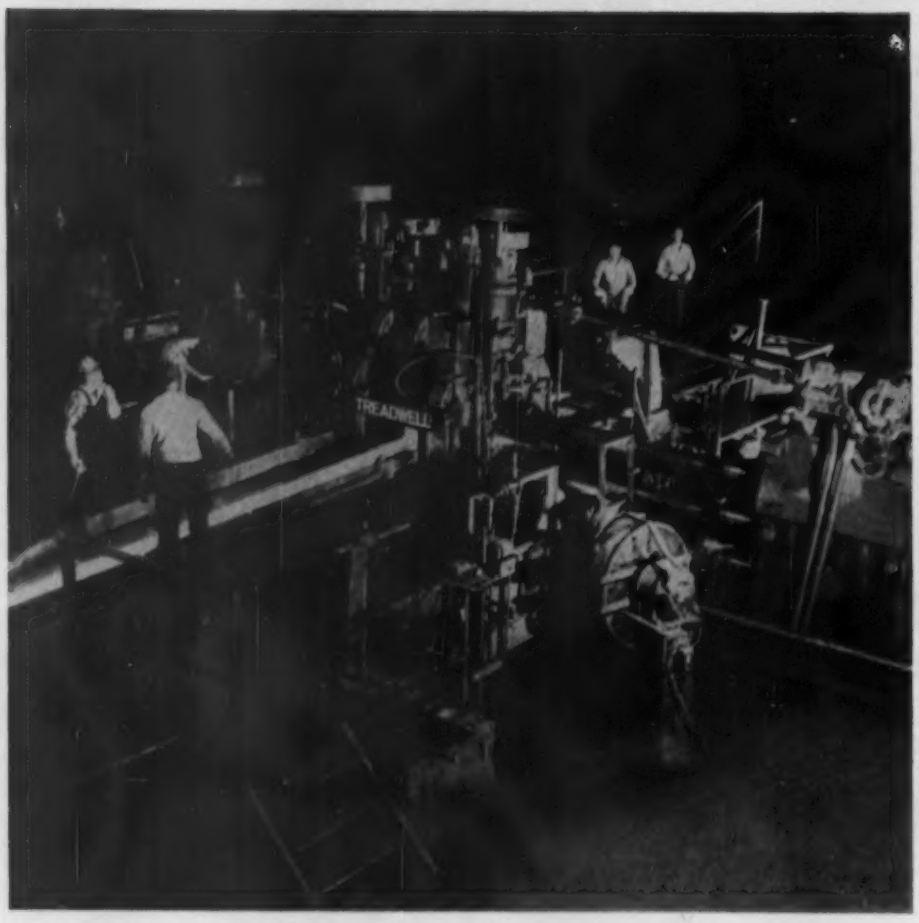


HEPPENSTALL PRODUCTS
... engineered and built for better production

For complete information and technical assistance, call Heppenstall Company, Pittsburgh 1, Pa. Sales offices and representatives in principal industrial centers.

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FOR HIGHEST PRODUCTION STANDARDS

Treadwell



Manipulators, Mill, etc.
Mills, Blooming & Billet
Mills, Merchant & Bar
Mills, Rod
Mills, Sheet
Mills, Strip (Cold)
Mills, Strip (Hot) & Skelp
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Tables, Mill
Tables, Tilting & Lift
Tables, Transfer
Transfers

Coilers & Reels
Conveyors, Coil
Drives
Ejectors, Furnace
Gauges, Shear, Saw, etc.

Beds, Cooling
Beds, Inspection
Bumpers, Furnace

Pushers, Furnace
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Handling Equipment (Kick-offs, Pliers, Cradles, etc.)

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Ni-Hard and Ductile Iron Castings

Three-High Mill for rolling precision rounds and squares up to and including 5" round or square. The mill is equipped with motor operated screw-downs for both top and bottom rolls.

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WOrth 4-3344

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ATlantic 1-2883

gree. Third, that in rooms heated by such stoves the carbonic acid of the atmosphere and that emanating from persons are apt to be decomposed and set oxide of carbon at liberty. Fourth, that the gas may proceed from different sources, viz., from a cast iron stove, since it will penetrate through the metal, from the direct action of the oxygen of the air on the carbon of the cast iron at a red heat, from the decomposition of carbonic acid or lastly from the organic dust suspended in the air. Fifth, the want of ventilation may greatly increase the danger, and sixth, that iron stoves not internally lined with nonconducting clay to prevent their becoming red hot, are highly injurious to health.

June 24, 1869

Coke Use Grows Pennsy Report Shows

The percentage of Connellsville coke used east of Pittsburgh is largely on the increase, notwithstanding the great reduction in the make of pig iron and the production of coke. The annual report of the Pennsylvania Railroad shows that the east bound coke tonnage from the Connellsville region increased 34,307 tons in the year 1884, while the west-bound tonnage decreased 367,527 tons. The entire coke tonnage of the Pennsylvania Railroad for the year 1884 was 2,846,126 tons, of which 2,367,606 tons were from the Connellsville region.

Mar. 12, 1885

Rapid Transit Rumors

The latest rapid-transit rumors in Brooklyn refer to a syndicate who contemplate building steel elevated railroads in the main thoroughfares, with a lateral bridge connection at the City Hall.

Mar. 12, 1885

HY-ALLOY STEELS CO.

30 NORTH LA SALLE STREET, CHICAGO 2, ILLINOIS

Telephone: RAndolph 6-5253-5216

ALLOY AIRCRAFT QUALITY CARBON

ROUNDS SQUARES HEXAGONS FLATS

HOT ROLLED COLD FINISHED

ALLOY SEAMLESS TUBING

(A4140 COLD DRAWN ANNEALED)

AVAILABLE FOR IMMEDIATE DELIVERY FROM CHICAGO WAREHOUSE

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WICHITA 1, KANSAS—R. F. MEYER—WHitehall 3-3911

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WRITE FOR CATALOG AND PRICE LIST YOUR INQUIRIES WILL BE GIVEN OUR PROMPT ATTENTION

the Newest Star on the STAINLESS STEEL horizon

1946 MicroRold® 36

1953 VERI-THIN MicroRold®

The same high quality and extreme accuracy of gauge that is now associated with MicroRold stainless steel sheets up to 36" wide will soon be available in sheets up to 48" wide.

Washington Steel Corporation now has under construction a 52" Sendzimir Cold Rolling Mill together with collateral facilities capable of producing 48" wide sheets. This expansion program, costing approximately $2,600,000, is expected to be completed early in 1956.

"MicroRold 48" stainless sheets will provide greater economy in application and production of stainless steel equipment.

1956 MicroRold® 48



Washington Steel *Corporation*

Washington Pennsylvania

QUOTES: 1855—1955

Etching Iron, Steel

The fact has been demonstrated quite satisfactorily of late that much information is obtainable as to the chemical composition and physical character of iron and steel by etching it, and noting the changes which take place during the operation, and the appearance of the surface after it is completed. In this connection the most valuable etching substance is found to be a mixture of equal parts of hydrochloric acid and water, to which is to be added a trace of chloride of antimony one drop to the quart.

Nov. 9, 1876

Oregon Iron Mine

An iron mine, it is said, has been discovered near Chehalem Valley, about thirteen miles from Portland, which promises to yield a rich supply of superior ore. Horse-shoes and nails have been made of this iron, which are pronounced to be of the best quality. The neighborhood of the mine is heavily timbered with fir trees, which can be used for smelting the ore. It is thought that the discovery is a very valuable one.

April, 1859

Telegraph from Trains

The Phelps Induction Telegraph Co. have been experimenting . . . with a new invention by which it is claimed that a train in motion can be kept in constant telegraphic communication with the stationary world.

Feb. 19, 1885

Horse-shoe Iron Duty

A question has arisen in the Treasury Department respecting the proper classification of horse-shoe iron and whether it is dutiable as bar iron or rolled iron not otherwise provided for. There seems to be a disposition on the part of importers to reopen disputed questions under the old tariff.

Apr. 9, 1885



Advanced know-how makes the difference

Hitting the target is the result of know-how based on experience and experiment . . . of knowledge, imagination, skill and an intangible spirit that seeks perfection. Here are the highlights of casting methods which show how advanced know-how at Cooper Alloy has made it possible to produce intricate stainless steel parts to quality standards formely considered impossible.

SHELLCAST®

The production of cast shapes in thin, light weight, resin-bonded shells was born of the necessity to produce molds faster, more economically and with greater accuracy . . . and to cast parts to closer tolerances, with superior surface finish, greater legibility of markings and better appearance, as well as with thinner sections, small cored holes, well detailed contours, minimum draft and intricate recesses. These advantages are available to design engineers and manufacturers who specify—"Shell-cast by Cooper Alloy" —for their stainless steel components.

SHELLCORE

When the interior surface of the casting is as critical as the exterior, the core becomes a problem. The answer lies in the production of hollow "Shell" cores of superior accuracy and fine detail, which fit the mating molds much more closely than sand cores ever could. For extremes of tolerances—inside and out—Cooper Alloy *advanced know-how* with shell molds and shell cores makes the difference.

COREMOLD

Where specifications demand extreme smoothness of surface and close matching of many components, the use of special core mold assemblies becomes necessary. Core sand is used for making molds which provide excellent mating surfaces for cores and assure extra smoothness to the casting surface. Cooper Alloy *advanced know-how* puts coremold methods at your disposal.

CENTRIFUGAL CASTING

Casting centrifugally offers many specific advantages, including the ability to cast very thin, light weight airfoil sections. Whether made in metal molds or in sand, castings by the centrifugal method meet highest quality standards, particularly when backed up with Cooper Alloy *advanced know-how*.

SAND CASTING

The heart of the foundry industry still lies with quality sand castings. But so important is the engineering, the patternmaking, the heading and gating, melting, molding, pouring, heat treatment, pickling . . . so critical is the use and application of x-ray, zyglo, gamma ray, pressure testing . . . so variable are the control items envolved in pouring thirty different high alloys . . . that even in the production of castings by "conventional methods" quality depends on experience. Here too, Cooper Alloy *advanced know-how* makes the difference.

Tomorrow is ever with us . . .

Our search for better ways to produce quality stainless steel castings more economically . . . goes on continually. Research links us with tomorrow and assures you of the best in thinking, the best in technology. Cooper Alloy *advanced know-how* can make the big difference in your product. Your inquiries are invited.

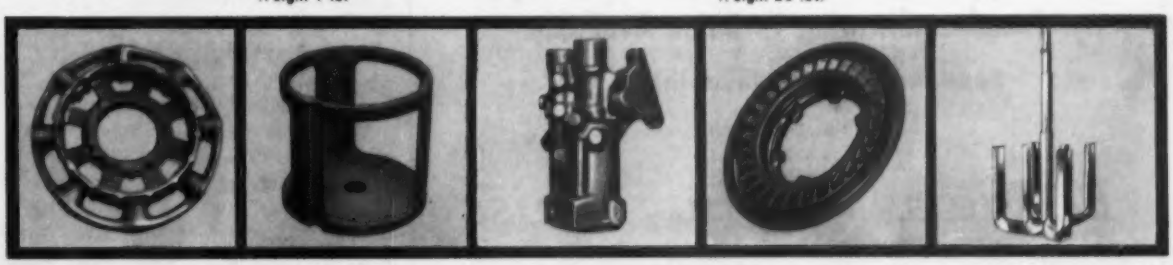
JET ENGINE SUPPORT
produced by Shellcast.®
Weight 35 lbs.

INSTRUMENT HOUSING
produced by combining Shellcast® and shellcore.
Weight 1 lb.

JET AFTERBURNER COMPONENT
produced by coremold.
Weight 11 lbs.

SUPERCHARGER DIAPHRAGM
produced by centrifugal casting using coremolds.
Weight 25 lbs.

CHEMICAL AGITATOR
produced by sand casting.
Weight 2500 lbs.



COOPER ALLOY
CORPORATION • HILLSIDE, N. J.
Found-ry Products Division

Editor Built Early Bullet Proof Car

Describing a bullet proof railroad car ordered in the United States by the Spanish Government for use in Cuba, THE IRON AGE of May 3, 1877, quotes the Baltimore Sun to the effect that "there has just been completed at the car shops at York, Pa., the first bullet proof car ever manufactured in the United States. The car is 31 feet long, 8 feet high, and furnished with all the latest improvements in ventilation, etc. The body below the windows is covered with ⅜ inch iron and panels between the windows and the body above them are covered with 3/16 inch steel. The windows can be closed with steel slides, and when they are down the entire car is bullet proof."

In comment on this news, THE IRON AGE points out that "this may be the first bullet proof passenger coach, but is is certainly not the first bullet proof car ever built in the United States. The writer assisted in 1862 in building a bullet proof car which was used for some time on the Atlantic and North Carolina Railroad, then run by the United States military forces. The car was made by putting up a stout frame on an ordinary flat car and boarding it over, the planking being covered with boiler plate on the sides and old rails on the ends, which were inclined. The car was armed with a small brass howitzer and had a number of loop-holes for musketry. It was shown to be bullet and even shot proof by actual demonstration on several occasions."

May 3, 1877

WEISS STEEL CO., INC.

600 West Jackson Boulevard

CHICAGO 6

Telephone CEntral 6-1936

WAREHOUSE INVENTORY

H. R. Bars (Alloy)	C. D. Bars (Carbon)
H. R. Bars (Carbon)	C. D. Bars (Alloy)
H. R. Plates	C. R. Sheets
H. R. Sheets	C. R. Strip
H. R. Strip	Bright Basic Wire
Structural Shapes	Reinforcing Bars
Stainless Steel Bars & Shapes	

Complete Shearing Facilities Available

Send for Our Free Inventory Lists

Over 35 Years of Steel Service

Be Weiss Buy Weiss

Members Of:

Purchasing Agents Association of Chicago

Chicago Association of Commerce and Industry

National Association of Manufacturers

Pocketbook Lock

An invention likely to be of considerable use has just been patented by a Chicago genius. It consists in a safety lock to be fastened inside the pocket of ladies' or gentlemen's garments to prevent the stealing of pocketbooks and other valuable things.

June 8, 1871

Experiment In Ohio

The experiment of using charcoal furnaces for the manufacture of iron with stone-coal, without any change of machinery, hearth and inwall, has so far not been very successful. While some furnaces have, for a little time, done well, others have chilled and scaffolded, and been obliged to blow out.

July 6, 1876

Velocipede Manual

Literature keeps pace with the progress of industry. Our shops have supplied the material while the inventive skill of our mechanics has fashioned the American velocipede equal to that of any other country, but the necessity remains for a work giving practical instructions to those learning to manage the instrument. This want has been supplied by the "American Velocipede Manual," which gives full instructions to the beginner and contains valuable information for experts.

April 1, 1869

Chinese Labor Force

Business item. Mr. C. Koopmanschoop, the coolie laborer contractor has agreed to furnish a St. Louis foundry with 50 skilled Chinese laborers at $1.25 per day, the laborers to be delivered at the foundry in August.

Brought In 50,000

Mr. K. is a Hollander by birth, a resident of California and has made six voyages to China during the past ten years, bringing over in person or by deputy not less than 50,000 Chinamen, now settled in California. He supplied 10,000 coolies to the Central Pacific Railroad Company.

Aug. 5, 1869

ACKNOWLEDGMENT

In addition to those mentioned in the text or in photo credits, the editors also want to thank the following for their help in preparing this section: John W. W. Sullivan, American Iron and Steel Institute; and the following companies: Aetna-Standard Engineering Co., Allis Chalmers Mfg. Co., Continental Foundry & Machine Co., Granite City Steel Co., Loftus Engineering Co., Lone Star Steel Co., Mesta Machine Co., Morgan Construction Co., Pittsburgh Lectromelt Furnace Corp., United Engineering & Foundry Co., Wean Engineering Co., Wellman Engineering Div., and the Wire Association.



The above Knurled Head Machine Screw represents another difficult cold heading job successfully accomplished at lower cost per unit by Keystone "Special Processed" Cold Heading Wire.

The superior grain flow characteristics of "Special Processed" Wire provide the desired upsetting and die forming qualities necessary to form the thin head section without cracking. The structural soundness and uniformity of "Special Processed" Wire further proved itself by trouble-free machine operation, longer die life and a finished product of the highest quality.

On your next recessed head or other difficult cold heading job, try "Special Processed" Wire. See your Keystone representative or write for more information.

Keystone Steel & Wire Company
Peoria 7, Illinois
Industrial Wire Specialists



...the trademark of

THE COLORADO FUEL

DENVER

Among the nation's top steel producers, CF&I is renowned throughout America for the high quality and reliability of its steel products for farms, railroads, mines and industry. This is the natural consequence of the CF&I policy which stresses "not merely to sell; but to serve . . . not only to make good steel products; but to make them still better . . . not only to fulfill today's requirements; but to anticipate tomorrow's."

Because these are the principles on which CF&I was founded and continues to grow, you can depend upon it to serve you—not only today, but in the challenging years ahead.

3083

CF&I STEEL PRODUCING PLANTS

CF&I Pueblo, Colorado

Blast Furnaces and Open Hearths producing pig iron, ingots, blooms, billets and rods.

CF&I Buffalo, New York

Blast Furnaces and Open Hearths producing pig iron, ingots, blooms, billets and rods.

CF&I Claymont, Delaware

Open Hearths producing ingots and steel plate.

CF&I Roebling, New Jersey

Open Hearths producing ingots, blooms, billets and rods.

CF&I Brooke, Pennsylvania

Blast Furnaces producing basic, Bessemer, foundry, malleable and low phosphorus pig iron.

AND IRON CORPORATION

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CF&I FABRICATING PLANTS

The quality of CF&I steel products is firmly controlled since the requirements of each product determine the analysis of the steel.

CF&I Buffalo, New York

Fine and Specialty Wire of all types including Manufacturer's Wire (Basic, Spheroidized, Annealed, Tempered, Bright and Liquor Finish, Low and High Carbon)—Welded Wire Fabric—Chain Link Fence.

CF&I Claymont, Delaware

Flanged and Dished Heads—Carbon and Alloy Steel Plates—Stainless-Clad Plates—Nickel Lectro-Clad Plates—Manhole Fittings and Covers—Large Diameter Welded Steel Pipe—Flame Cut Steel Plate Shapes.

CF&I Clinton, Mass.

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CF&I Mt. Wolf, Pennsylvania

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CF&I Palmer, Mass.

Wire Rope—Wire Rope Slings—Wire Clothesline—TV Guy Wire—Aircraft Control Cable.

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Bar, Rod and Structural Products—Grader Blades and Cutting Edges—Rails and Accessories—Chain Link Fence—Woven Wire Fence—Fence Stays—Fence Posts—Corn Cribs—Welded Wire Fabric—Nettings—Grinding Balls and Rods—Screen and Grizzly Bars—Rock Bolts—Wire Strand—Clothesline—Barbed Wire—Manufacturer's Wire (Basic, Chain, Spring, Stapling, Weaving, Welding)—Merchant Wire (Annealed and Galvanized)—Nails—Bolts—Nuts—Spikes—Seamless Casing and Tubing.

CF&I Roebling, N. J.

High Carbon Steel Wire (Hard Drawn, Spheroidized and Tempered)—Rope Wire—Tire Bead—Hose Wire—ACSR Core Wire—High Carbon Spring Steel Wire (All grades, tempers and finishes)—Regular, Sash Balance and Flapper Valve Wire.

CF&I Roebling (Trenton), N. J.

High and Low Carbon Flat Wire (All tempers, edges and finishes)—Brush, Corset, Casing, Heddle and Drop Wire, Umbrella Wire and Tape Lines—Wire Rope—Strand, Aircord and Fittings—Wire Rope Slings—Electrical Wire and Cable and Magnet Wire.

CF&I So. San Francisco, Calif.

Galvanized and Annealed Merchant Wire—Galvanized and Annealed Stone Wire—Bale Ties—Baling Wire—High and Low Carbon Wire—Galvanized and Annealed Wire—Copper Coated Wire—Rope Wire—Welding Wire.

CF&I Worcester, Mass.

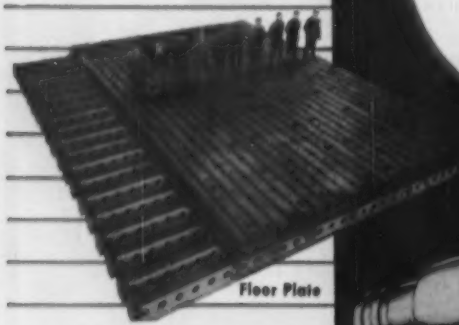
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18" 3Hi Bar Mill

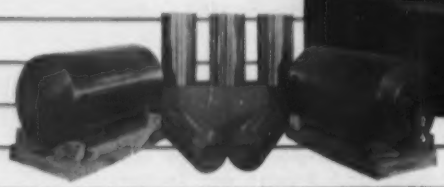
Hyde Park

ROLLS and ROLLING MILL EQUIPMENT



Floor Plate





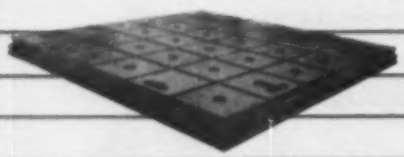
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The Red circle on the end tells you that the Roll on which it appears is a Hyde Park Roll.

But the Hyde Park Red Circle is more than just an identifying mark; it is our pledge of quality, of performance, of dependability, backed by more than fifty years of experience, of know-how, and of devotion to the highest standards of workmanship.

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The answer to most of your questions about stainless steels are right at your finger tips, when you use Crucible's unique new Stainless Steel Selector.

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And almost as fast as you get the answer, you can get the steel you need. For many of the REZISTAL stainless steels shown on the Selector are carried in stock in Crucible warehouses conveniently located throughout the country.

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Start with the problem. For example, resistance to corrosion in contact with copper sulfate. Just set the slide at the proper index number shown on the Selector (in this case on the back), and you have the answer in a second – grades 302 and 316 are fully resistant to this form of attack.

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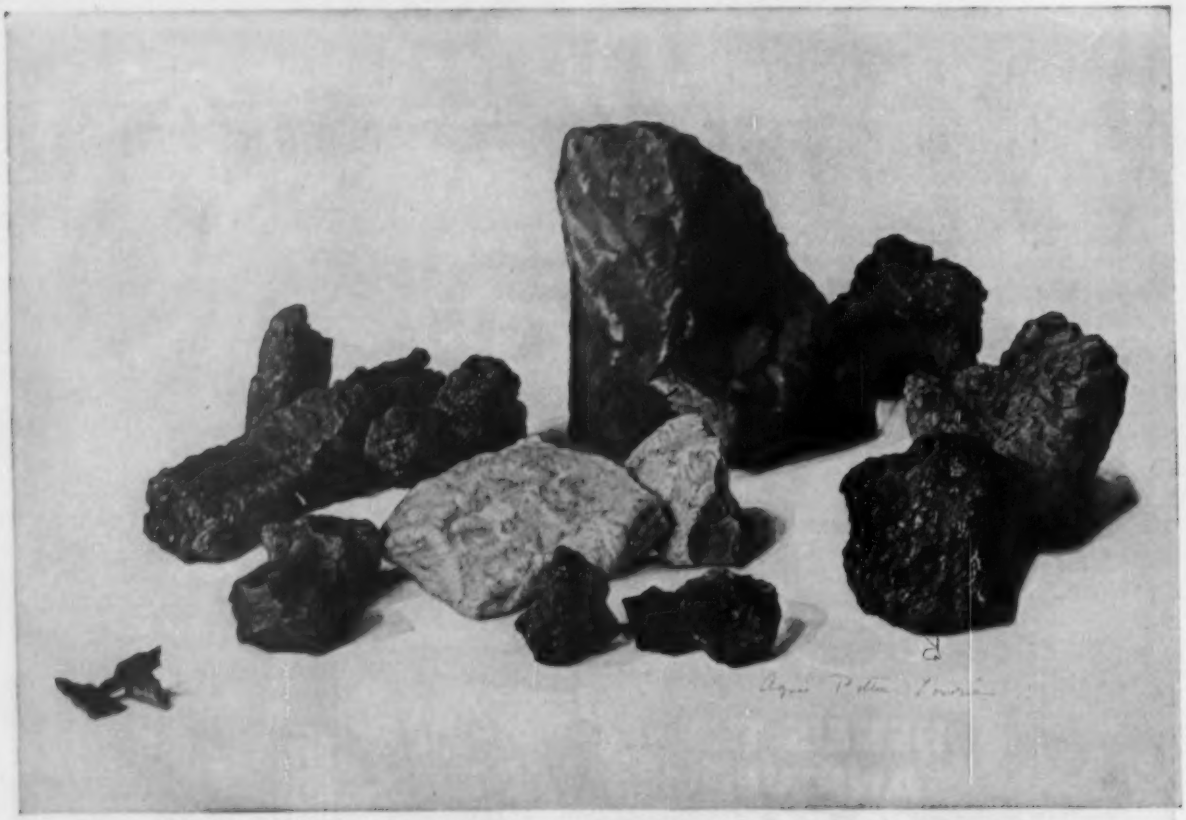
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"Fuel for the Furnaces" by Agnes Potter Lowrie, famed artist daughter of a noted steelmaker. In this first of a specially commissioned fine arts series, Mrs. Lowrie finds beauty in weathered iron ore, creamy limestone, shaggy coke — basic elements so common most steelmen take them for granted.

The Fine Art of Steel Making

For 60 years the history of American industry has been the story of steel. You know the landmarks. The old, slow hand mill. Table trains with their lusty offspring, the continuous strip mill. And more recently, the speedy, almost automatic four-high mill.

During these 60 years every forward step in steel production has been paralleled by an equal advance in Ironsides Gear Shield lubricants. Heavy duty Gear Shield, once hand-paddled onto exposed gears, is now formulated with a solvent for quick spray application.

With increased use of encased gears, Gear Shield was produced in liquid form for pouring, pumping or timed-jet application. As pressure on production increased, Ironsides was among the leaders in developing extreme pressure lubricants.

Today, so widespread is the acceptance of Ironsides lubricants that other makers often refer to their own products as "gear shields", even though Gear Shield is an Ironsides trade mark.

Ironsides is not mass production. We are the "custom tailors" of lubrication. Our special position is due in large part to our flexibility. We can—and do—formulate for individual applications and supply these formulas in any quantity from pails to tank cars.

We like tough problems, and we've solved a lot of them. For example, Palmoshield, replacement for palm oil and most important advance in lubrication since World War II.

If you have a special problem, we'd like to help you lick it. A letter or phone call will summon one of our research engineers. Address The Ironsides Company, Columbus 16, Ohio.

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Ironsides

By the makers of Palmoshield • "the palm tree that grows in Ohio"

Quality Steel without Hot Tops

Tailor-Made Presses to suit the Requirements of the Dornin Process for the Production of sound ingots



2500 Ton Piercing and Upsetting Press shown at the start of the Piercing Operation

1500 Ton Open Forging Press showing upset Billet prior to forging into a square

Installed at the Green River Steel Corp., Owensboro, Ky., the first plant to commercially produce sound ingots made by the Dornin Process.

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103 years of progress

1852 La Belle Cut Nails



Though modern production techniques have taken over laborious hand operations, La Belle Cut Nails still prove the most effective wedge for hardwood and construction block. Cut from steel of controlled analysis and hardened by special process, La Belle Cut Nails hold longer, get work done faster with fewer nails. Sizes and patterns to meet specific needs.

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GALVANIZED SHEETS



Here is the ultimate in galvanized sheets, with the tightest zinc coating yet produced . . . so tight that, regardless of operation, it won't crack or flake. Here are galvanized sheets so ductile, so tight coated, you can use them to make anything you can make of steel sheets. Try Wheeling SOFTITE. See for yourself why it's been acclaimed the ideal galvanized sheet. Wheeling Steel Corporation, Wheeling, W. Va.

LANDMARKS
in the field of steel progress pioneered by Wheeling

1852 La Belle Works organized for the manufacture of cut nails...eventually leads to Wheeling being called the "Nail City"

1907 First Organized Industrial Safety Program . . . idea spreads throughout the nation

1928 COP-R-LOY, the copper bearing steel pipe, developed, adding corrosion-resistance to steel

1928 Perfection of Ductillite, the original cold reduced tin plate, which revolutionized the tin plate industry

1953 Perfection of Wheeling SOFTITE, the continuously coated galvanized sheet with the tightest zinc coating yet produced

1955 Due to unprecedented acclaim and demand, Wheeling is tripling its production facilities for SOFTITE galvanized sheets

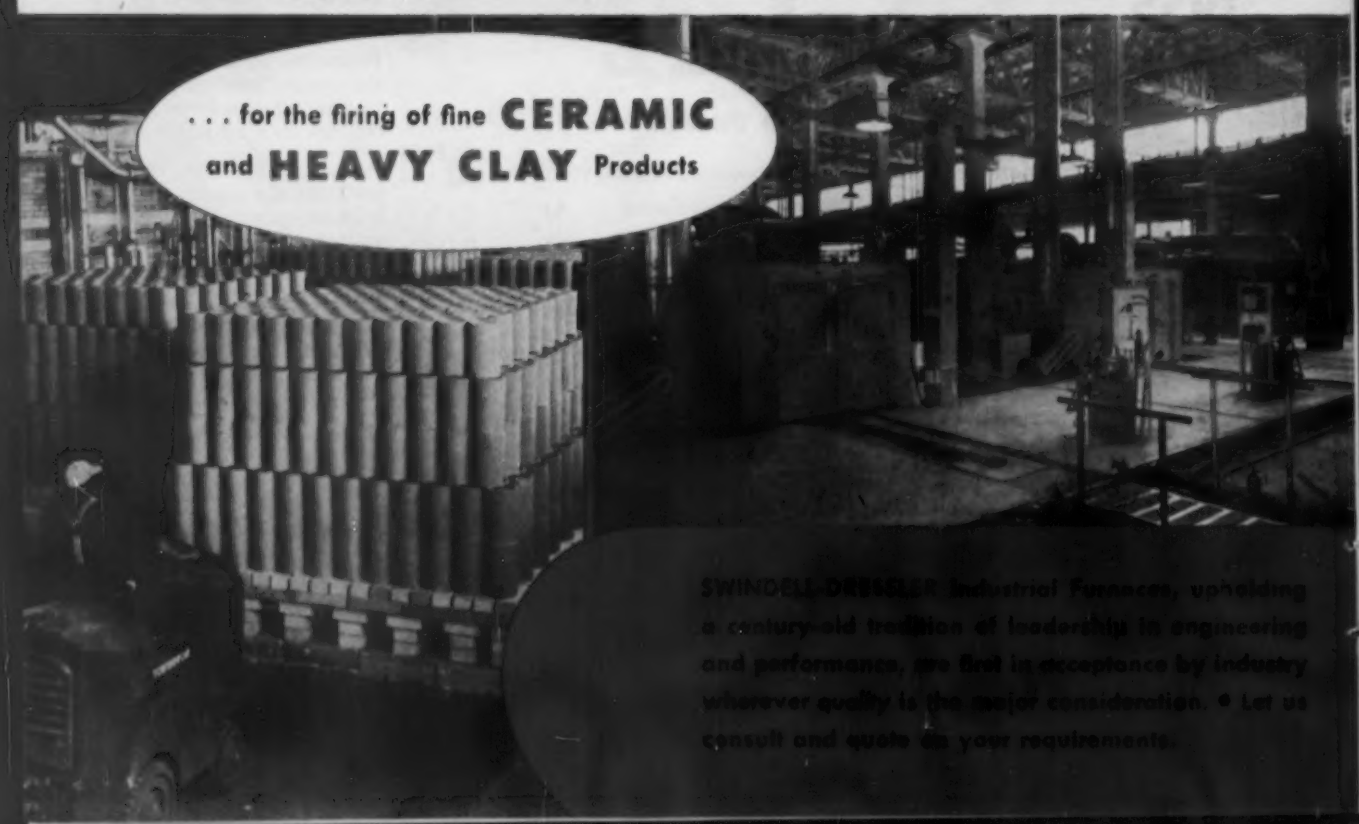


103 years and still growing . . .

IT'S WHEELING STEEL

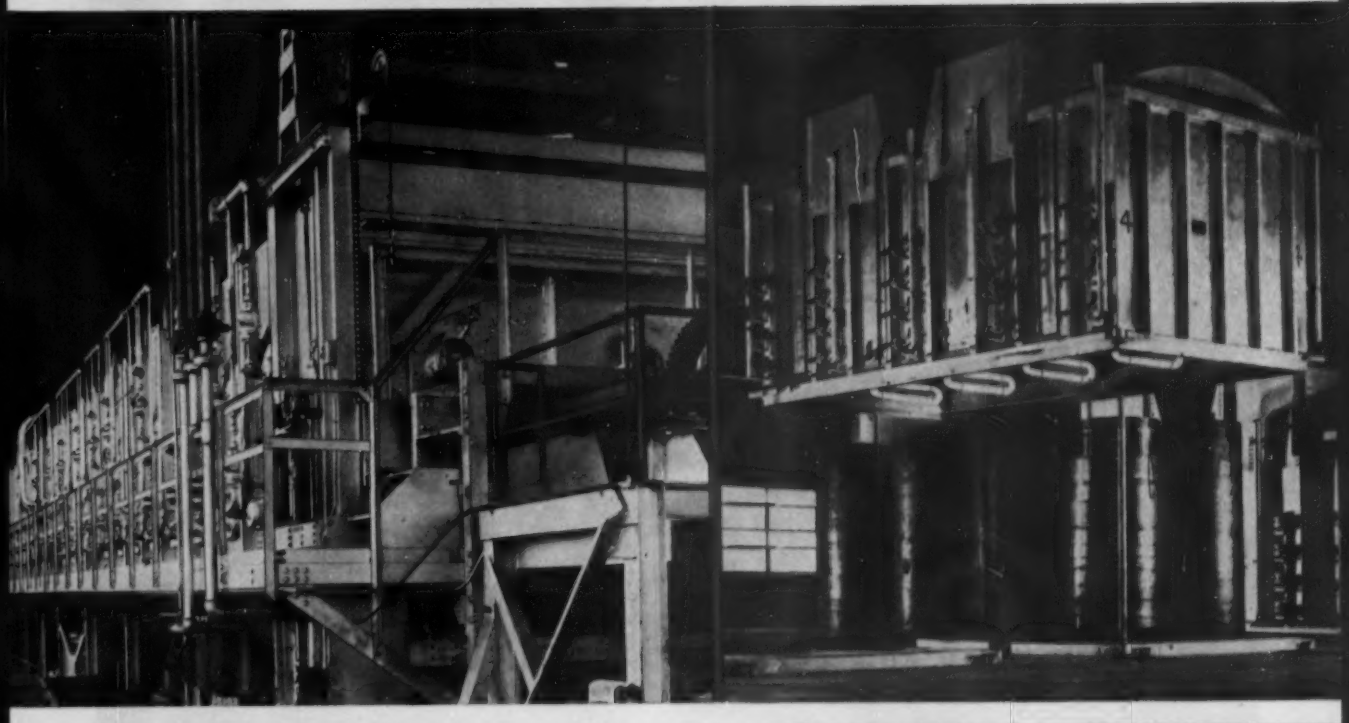
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YOU'LL FIND THE HISTORY OF TUBING IN

TOMORROW'S APPLICATIONS

One of the most important reasons why the past 100 years have been so significant in metalworking is the *attitude of those who have contributed to it.* Progressive thinking has developed a galaxy of new analyses, better heat treatment, improved welding techniques, and a world of revolutionary fabricating methods.

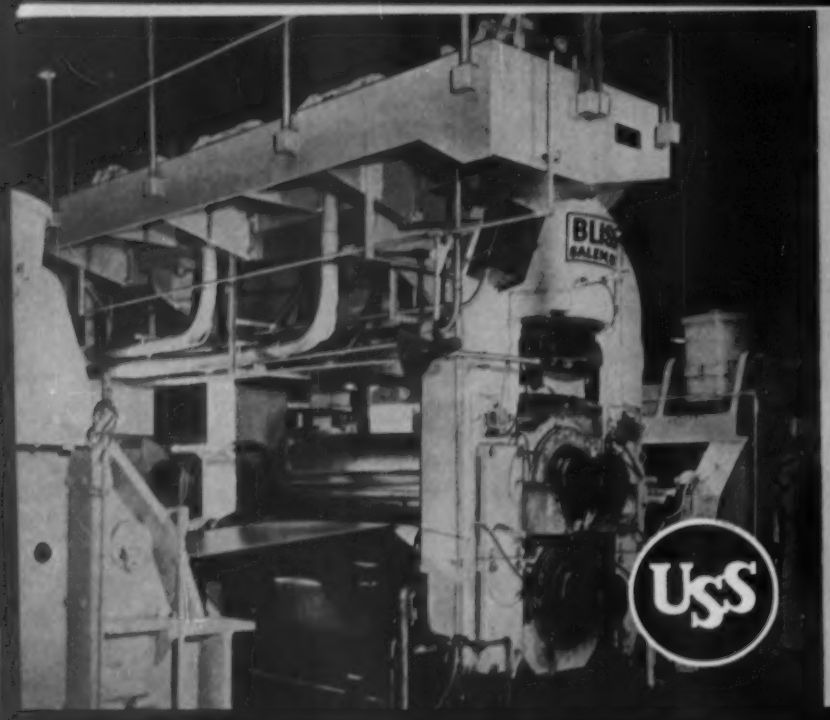
Tubing, for mechanical and pressure uses, has come into its own. Designers and fabricators find that tubing adapts itself to many of their needs, and offers strength-to-weight ratio often unmatched by bars and castings; the chemical process and petroleum industries, among others, have turned to the wide range of commercially available alloy and stainless grades of tubing to help conquer problems of corrosion, oxidation, pressure and temperature.

B&W pledges to continue its long record of excellence in creative metallurgy and precision manufacture of seamless and welded tubular products, with the development of new techniques and new analyses to keep abreast of industry's demand for new materials to meet new conditions. Already, in laboratories and in pilot plants, B&W is helping to write tomorrow's history today.



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Alliance, Ohio: Welded Carbon Steel Tubing
Milwaukee, Wis.: Seamless Welding Fittings

TA-5027(G)



"We want a faster pickle line"

This Bliss 32" x 80" Two-High temper mill at the entry end of the Fairless Works pickle line is new and unique to the steel industry. It reduces strip slightly (2 to 3% elongation) and pulverizes skin-tight oxides. Pickling acids attack surfaces faster, speeding the entire operation and making better, more uniform pickling possible. For the Fairless Works, Bliss also designed, built and installed an automatic 19" x 53" x 48" Two-Stand tin temper mill (needs only 3 men to operate it) and another 32" x 80" Two-High mill that eliminates an extra handling operation in tempering and flattening strip prior to shearing or slitting.

When you think of ROLLING MILLS— think of BLISS!

Here's the story of four who did



"Versatility . . . sheet-stock now, tinplate later"

At Pittsburgh Steel, this giant Four-Stand cold mill handles widths from 20 to 60 ins., thicknesses from tinplate to 16 gage. With its heavy housings it can also be set up to roll stainless. X-ray equipment spots variations in thickness as small as .0005" to permit immediate corrections. Other electronic devices control tension, shape and finish. Automatic coil handling equipment and the latest safety devices are used throughout. Bliss also installed a Four-High temper mill and a Two-High skin pass mill at the same Allenport, Pa. plant.

"We want speed throughout... in the mill and on coil handling, too"

By rolling more than 6000 fpm, this Bliss Two-Stand tin temper mill at Jones and Laughlin is one of today's fastest. These mile-a-minute speeds, though, called for a number of Bliss-developed design precautions: dynamic balancing of all rotating parts, gear-type couplings to assure uniform angular velocities. Moreover, semi-automatic terminal and auxiliary equipment—designed for extra large coils and quick strip threading—mean longer contact time, shorter loading periods and greater tonnage all along the line. Fast, reliable, safe, this Bliss mill is capable of better quality at higher speeds with easier control.



Whatever your problem in mills and accessories—speed... versatility... accuracy... in hot or cold rolling...ferrous or non-ferrous applications—whenever you think of rolling mills, think of BLISS.

For more information about others who thought of Bliss—for rolling mills and accessories—write today for Catalog 40-A. This 60-page brochure describes Bliss mill installations, terminal and auxiliary equipment.



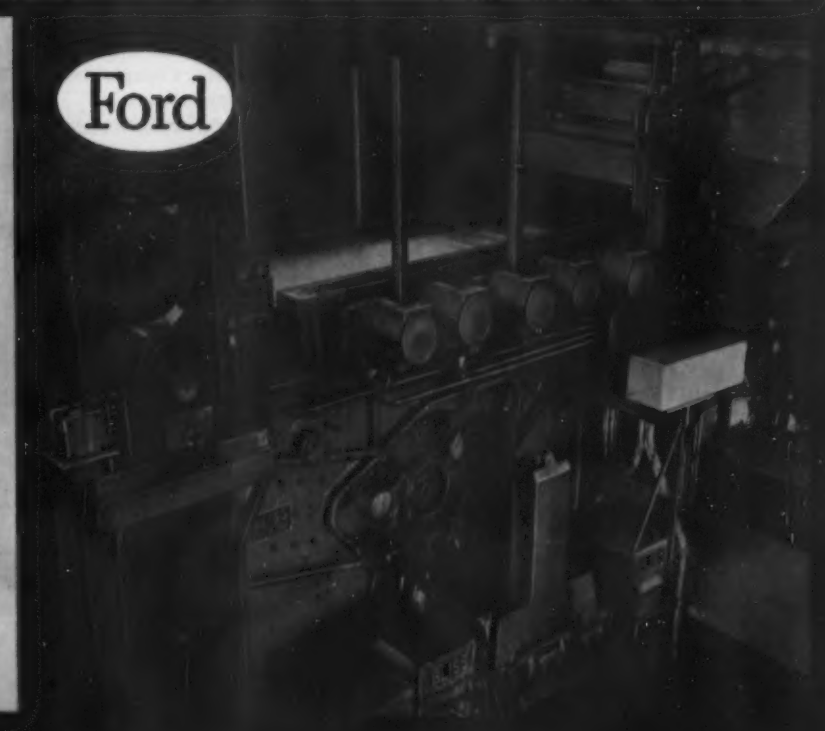
E. W. BLISS COMPANY, General Office: Canton, Ohio
ROLLING MILL DIVISION: SALEM, OHIO

BLISS
SINCE 1857

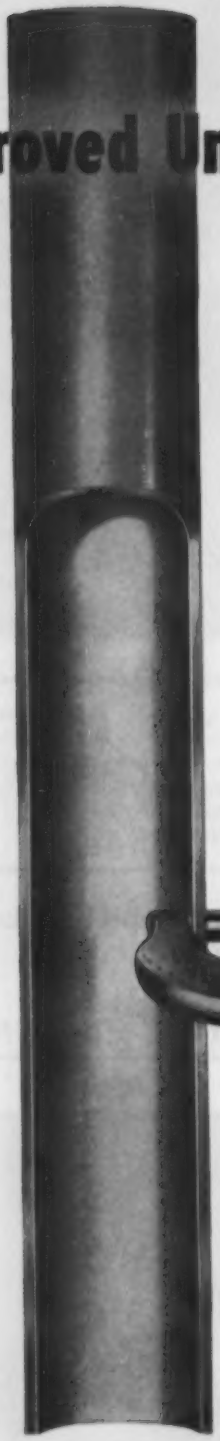
is more than a name...it's a guarantee

"Wind coils tight... and straight"

At River Rouge, this high-speed mandrel-type downcoiler by Bliss "rolls up" strip on an arbor with constant high-tension applied. Thus coils *are* tighter, more uniformly wound. Surfaces and edges are better protected, and better metallurgical characteristics are realized. After coiling, the mandrel collapses and facilitates coil stripping. Versatile, it handles a wide range of speeds, strip widths and gages. Bliss also designed and built a Four-High temper mill complete with heavy coil handling equipment for the Ford Motor Company.



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STANDARD CYLINDER TUBING

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Here's a busy part of an automobile shock absorber that's built for brutal punishment. It's Standard's modern "mirror-finish" Cylinder Tube. So that it won't weaken or leak under punishment, every inch of this tubular "toughie" must measure up to exacting specifications—in cylinder finish . . . in I.D. tolerances as close as .001" . . . in extreme uniformity of wall thickness and concentricity . . . in internal pressure resistance, to shocks up to 9000 P.S.I. The elimination of broaching or further processing of any kind effect significant savings for our customers in product assembly.



As you see here, the engineering involved behind the application of tubing to your product is *more than skin deep at Standard.* Our engineers will gladly show you why in helping you with your tubular application—whether it involves a simple structural or mechanical member . . . or a precision application.

Send for 8-page folder on all Standard products or see Sweet's Design Catalog.



The cylinder tube shown here is only one of many tubular products produced by Standard to precision requirements. For full information on our complete range of products, plant facilities and engineering assistance available to you,

Write The Standard Tube Co., Detroit 39, Mich.

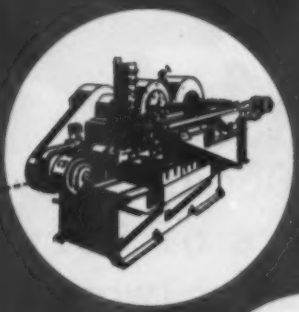


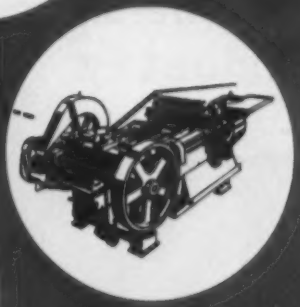
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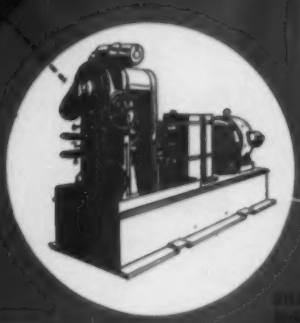
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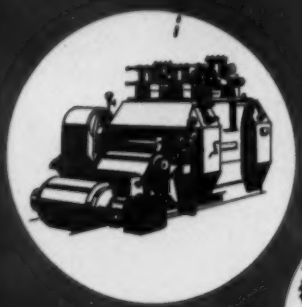
STEEL TUBING SIZES: ½" O.D. TO 8½" O.D.—.028 TO .260 WALL.
STAINLESS SIZES: ⅛" O.D. TO 4½" O.D.—.020 TO .154 WALL.

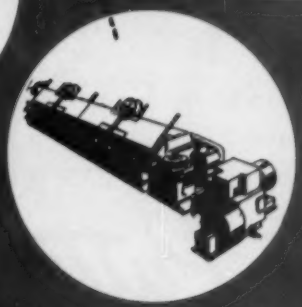
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If your metal-working machinery problem falls into any of these five groups, there are good reasons for looking to Waterbury Farrel for the answer.

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Waterbury Farrel can custom-engineer special equipment or adapt a standard machine to fit your specific problem.

For further information, write for free booklets on any of the machines mentioned on this page or contact your nearest WF office.



HERE'S A SAMPLE of Waterbury-Farrel mass production equipment in action. This complete WF automatic production unit combines a 40-ton double-acting, upright blanking and cupping press, a conveyor feed and four 7-station horizontal drawing presses to draw 340 zinc shells per minute.

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on the Occasion of
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We assume that all the reasons will be in your 100th Anniversary Edition so we will join your countless number of well wishing friends in reading avidly this human interest success story.

We extend our sincere congratulations. To us your 100th Anniversary is more than a success story. It is an inspiration.

Heyl & Patterson

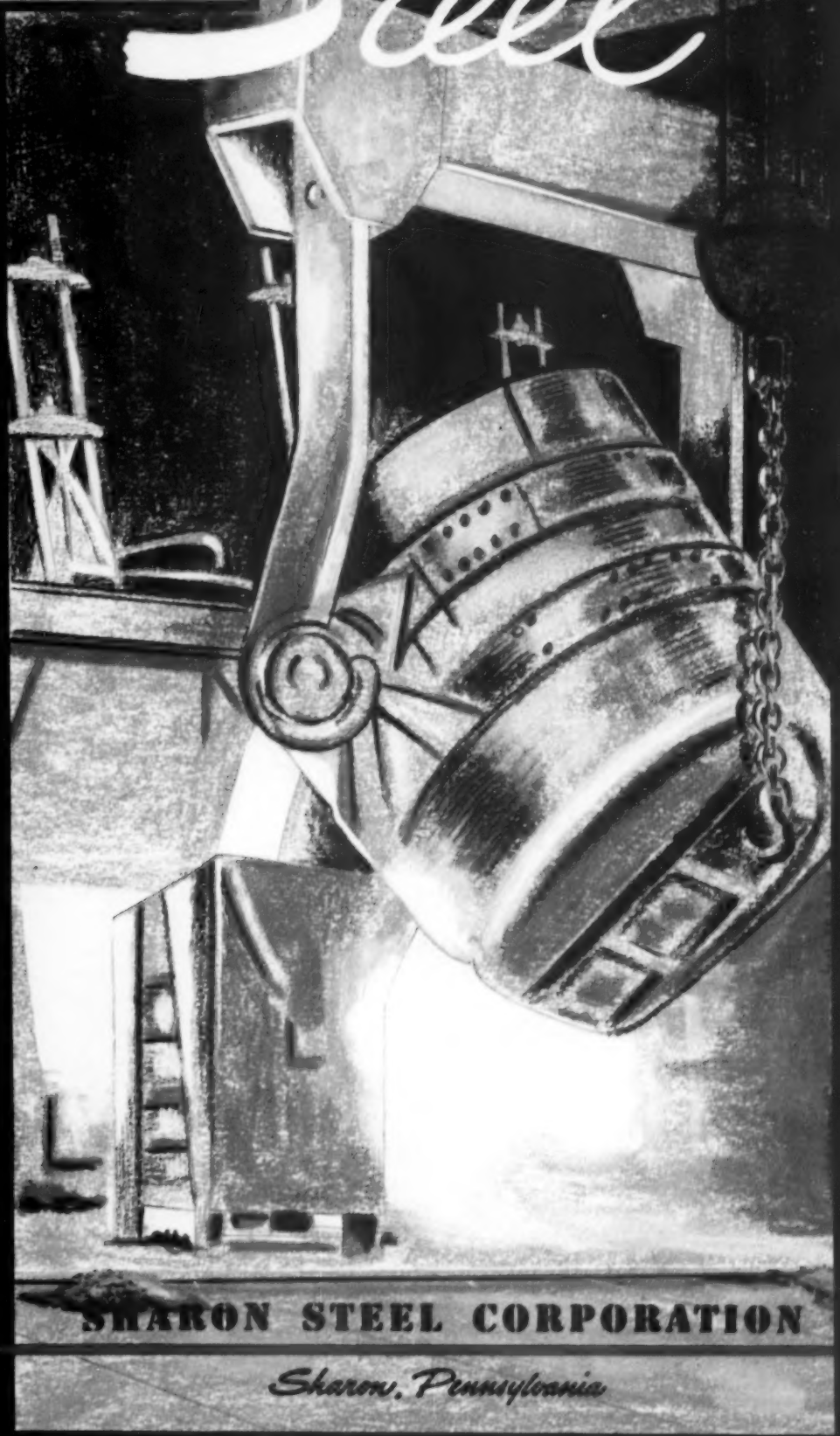
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Galvanite* Strip
Cutlery Steel
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Deoxidized Sheets
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Galvanized Sheets
Long Terne Sheets
Enameling Sheets
Sheet Bar
Billets
Blooms
Slabs
Open Hearth Steels
Electric Furnace Steels
Cor - Ten
N. A. X.
Copper Bearing Steel

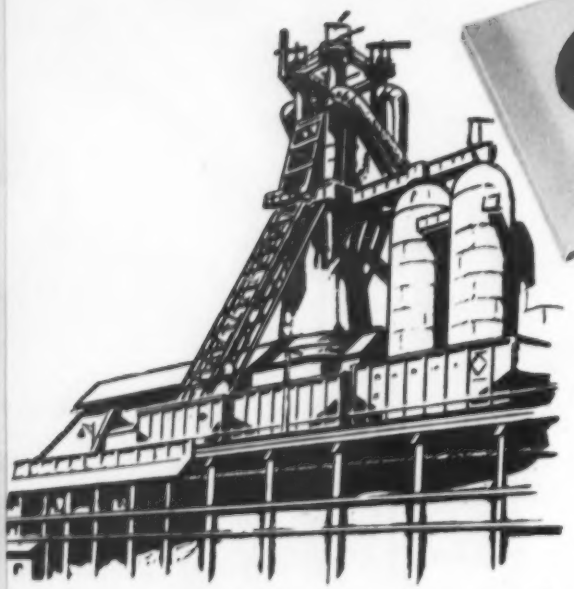
*Trade Name

SHARON STEEL CORPORATION

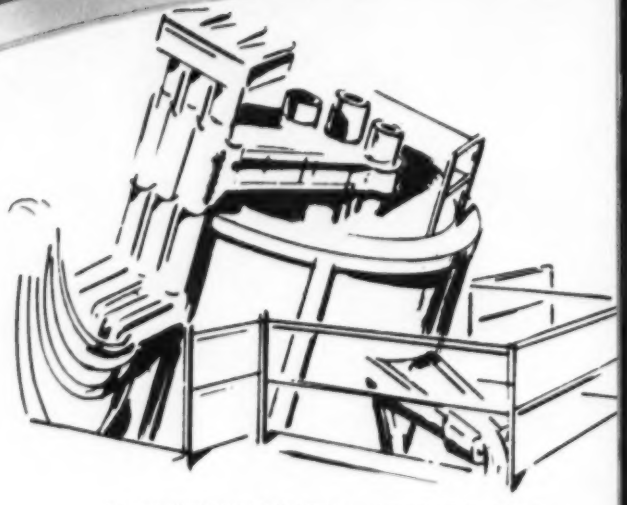
Sharon, Pennsylvania

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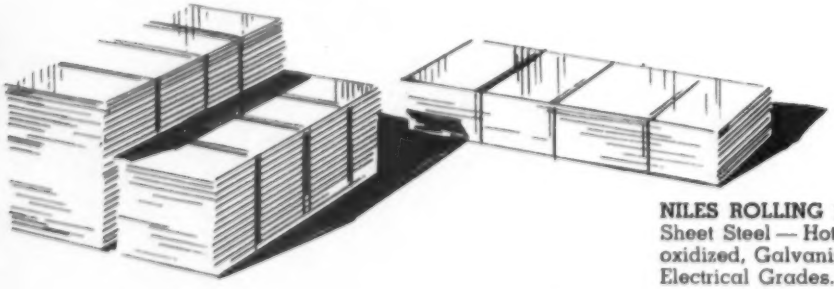
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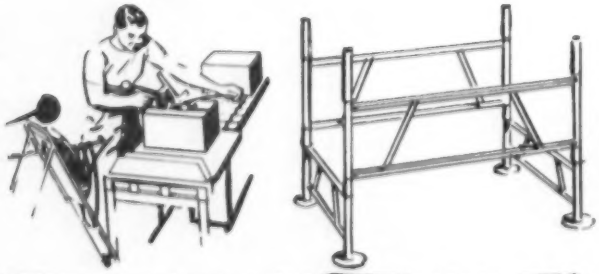
ROEMER WORKS — Farrell, Pennsylvania
Steel Manufacturing Division: Pig Iron, Open Hearth Ingots, Blooms, Slabs, Billets, Sheet Bar and Plates.
Finishing Division: Carbon, Alloy and Stainless Hot and Cold Rolled Strip Steel, Black, Pickled and Coated Strip Steel, Sharon Galvanite, Special Alloy Coated, N. A. X. and Cor-Ten Strip Steels.



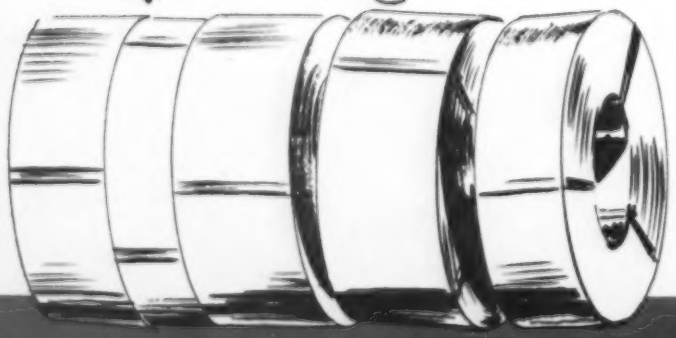
LOWELLVILLE WORKS — Lowellville, Ohio
Pig Iron, Open Hearth and Electric Furnace Ingots, Blooms, Slabs, Sheet Bar, Billets and Plates.



NILES ROLLING MILL DIVISION — Niles, Ohio
Sheet Steel — Hot Rolled, Pickled, Annealed, Deoxidized, Galvanized, Galvanite, Long Terne and Electrical Grades.



BRAINARD STEEL DIVISION — Warren, Ohio
Tensional Steel Strapping, Heavy Duty Strapping, Strapping Tools and Accessories, Electric Welded Steel Tubing, Tel-O-Posts, Steel Strong Posts, Brite-Lite and Standard Areawalls, Roll-Formed Steel Lintels, Anti-Checking Irons, Brainard Scaffolding.

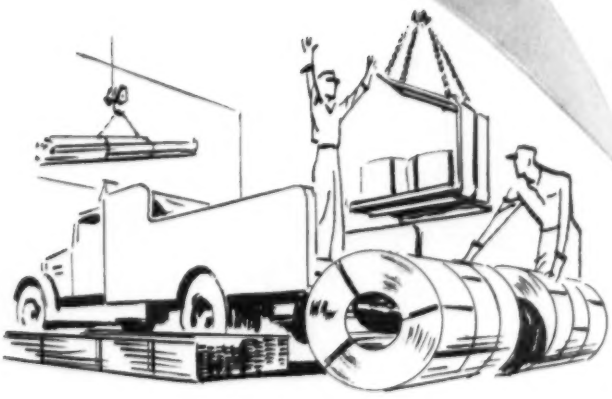


DETROIT TUBE & STEEL DIVISION
Detroit, Michigan
Cold Rolled Strip Steel, Low Carbon — High Carbon, N. A. X. and Cor-Ten Strip Steel.

SHARON STEEL CORPORATION
Sharon, Pennsylvania

SHARONSTEEL

STEEL

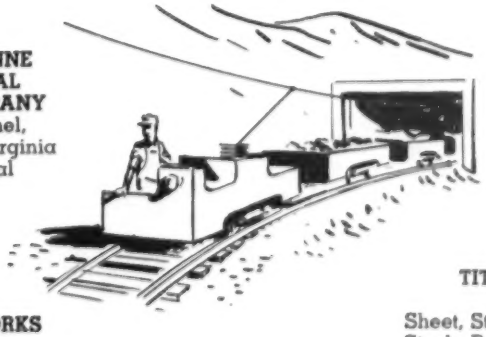




SHARONSTEEL PRODUCTS DIVISION
Detroit, Michigan and Farrell, Pennsylvania
Warehouse Distributors.



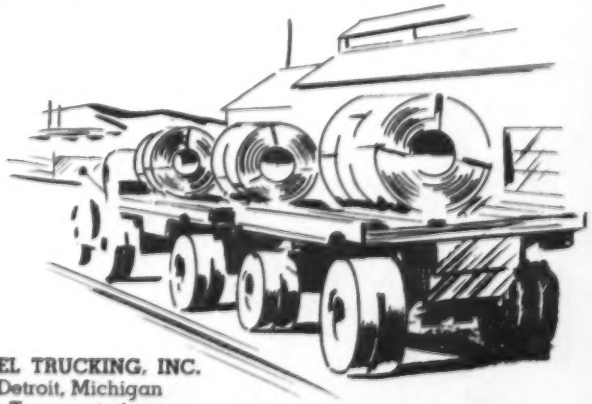
JOANNE COAL COMPANY
Rachel, West Virginia
Coal



MALLORY-SHARON TITANIUM CORPORATION
Niles, Ohio
Sheet, Strip, Forged Rod, Bar, and Billet Stock, Rolled Rod and Bar.

FAIRMONT COKE WORKS
Fairmont, West Virginia
By-Product Coke





CARPENTERTOWN COAL & COKE COMPANY — Mt. Pleasant, Pennsylvania
Coal and Bee-Hive Coke

STEEL TRUCKING, INC.
Detroit, Michigan
Transportation

Sales Offices

Chicago, Cincinnati, Cleveland, Dayton, Denver, Grand Rapids, Indianapolis, Los Angeles, Milwaukee, New York, Philadelphia, Rochester, San Francisco, Seattle, Montreal, Que., Toronto, Ont.

SHARON STEEL CORPORATION AND SUBSIDIARY COMPANIES

SHARON STEEL CORPORATION

Roemer Works—Farrell, Pennsylvania
Steel Manufacturing Division: Pig Iron, Open Hearth Ingots, Blooms, Slabs, Billets, Sheet Bar and Plates
Finishing Division: Carbon, Alloy and Stainless Hot and Cold Rolled Strip Steel, Black, Pickled and Coated Strip Steel, Sharon Galvanite, Special Alloy Coated, N.A.X. and Cor-Ten Strip Steels.

Lowellville Works—Lowellville, Ohio
Pig Iron, Open Hearth and Electric Furnace Ingots, Blooms, Slabs, Sheet Bar and Billets

NILES ROLLING MILL DIVISION—Niles, Ohio—Sheet Steel, Hot Rolled, Pickled, Annealed, Deoxidized, Galvanized, Galvanite, Long Terne, Electrical Grades

DETROIT TUBE & STEEL DIVISION—Detroit, Michigan—Cold Rolled Strip Steel

BRAINARD STEEL DIVISION—Warren, Ohio—Box Strapping and Heavy Duty Strapping—including Tools, Electric Welded Tubing, Tel-O-Post, Steel-Strong Posts, Brite-Lite Area-walls, Anti Check Irons.

JOANNE COAL COMPANY—Rachel, West Virginia—Coal

CARPENTERTOWN COAL & COKE COMPANY—Mt. Pleasant, Pennsylvania—Coal and Beehive Coke

FAIRMONT COKE WORKS—Fairmont, West Virginia—By-product Coke

SHARONSTEEL PRODUCTS DIVISION—Detroit, Michigan—Warehouse distributor

SHARONSTEEL PRODUCTS DIVISION—Farrell, Pennsylvania—Warehouse distributor

STEEL TRUCKING, INC.—Detroit, Michigan—Transportation



SHARON STEEL CORPORATION

SHARON, PENNSYLVANIA

SHARON STEEL CORPORATION

GENERAL OFFICES
SHARON, PENNSYLVANIA

SALES OFFICES

CHICAGO 4, ILLINOIS
1822 McCormick Building
Phone: Harrison 7-2526

CINCINNATI 2, OHIO
2407-08 Carew Tower Building
Phone: Main 1718

CLEVELAND 14, OHIO
1809 Union Commerce Building
Phone: Main 1-3135

DAYTON 2, OHIO
1801 Hulman Building
Phone: Fulton 5012

DETROIT 8, MICHIGAN
Tireman and Maple Avenue
Phone: Tiffany 6-1500

INDIANAPOLIS 4, INDIANA
415 Chamber of Commerce Building
Phone: Lincoln 7318

LOS ANGELES 13, CALIFORNIA
524 South Spring Street
Phone: Mutual 5481

MILWAUKEE 2, WISCONSIN
716 First Wisconsin
National Bank Building
Phone: Broadway 2-7450

NEW YORK 18, NEW YORK
500 Fifth Avenue
Phone: Pennsylvania 6-8744

PHILADELPHIA 3, PENNSYLVANIA
1138 Broad St. Station Building
Phone: Rittenhouse 6-0985

ROCHESTER 4, NEW YORK
503 Genesee Valley Trust Building
Phone: Baker 2540

SAN FRANCISCO 5, CALIFORNIA
902 Monadnock Building
Phone: Garfield 4335

SHARON, PENNSYLVANIA
South Irvine Avenue
Phone: 4141

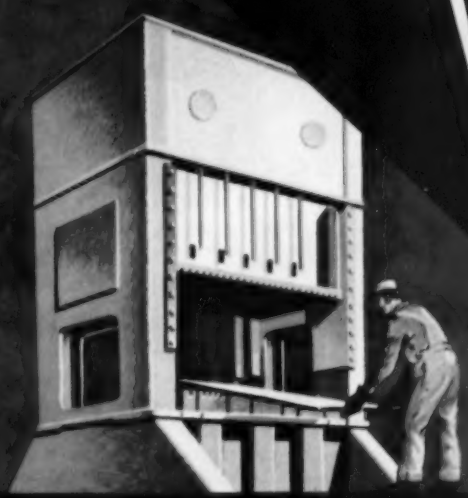
WASHINGTON 4, D. C.
Munsey Building
Phone: National 4874

CANADIAN REPRESENTATIVES

MONTREAL 3, QUEBEC
80 Prince Street
Phone: University 6-5761

TORONTO 17, ONTARIO
235 Wicksteed Avenue
Phone: Mayfair 0701

SHARONSTEEL



Two Steels Are Fused By Jessop Skill To Bring You Better Dies At Lower Cost

One milestone in Jessop's drive for absolute supremacy in the realm of fine specialty steels is its unique ability to fuse together tool steel and tough, non-hardening carbon steel and then roll them into one solid inseparable die section. The advantages to this exclusive process are great. Forms resist shock better, and can be more readily shaped. Dowel and screw holes may be drilled after hardening, and cost per pound to you is up to 40% less than solid tool steel die sections. Whether or not you buy die sections, this Jessop "first" should interest you. A company that has the spirit and progressiveness to constantly search for new ways to serve its customers better is a good one to do business with. Send us an order for one of the specialty steels shown below.

STAINLESS STEELS • HIGH SPEED STEELS • NON-MAGNETIC STEELS • HIGH SPEED TOOL BITS • HEAT RESISTING STEELS • STAINLESS-CLAD PLATES • CARBON AND ALLOY STEELS TOOL STEELS FOR SPECIAL PURPOSES • CAST-TO-SHAPE TOOL STEELS • HIGH SPEED AND ALLOY SAW STEELS • TEMPERED AND GROUND STRIP STEEL • COMPOSITE HIGH SPEED STEELS • STAINLESS AND HEAT RESISTING CASTINGS • COMPOSITE DIE STEEL SECTIONS PRECISION GROUND FLAT STOCK • DIE STEELS—HOT AND COLD WORK

JESSOP

STEEL COMPANY · WASHINGTON, PA.

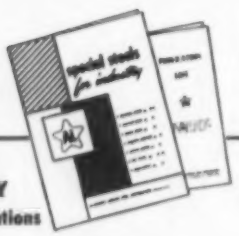
OFFICES IN PRINCIPAL CITIES

Jessop Steel of Canada Limited, Wallaceburg, Toronto

Jessop Steel International Corp., Chrysler Building, New York, N. Y.



Beautiful? YES—THEY'RE STAINLESS STEEL
Expensive? NO—THEY'LL LAST FOREVER!



WRITE TODAY
For These Publications

1. SPECIAL STEELS FOR INDUSTRY . . . 16 pages of essential data on the proper selection and application of principal AL special alloy products: stainless, tool and electrical steels and sintered carbides.

2. PUBLICATION LIST . . . a complete listing of all AL publications, both technical and non-technical (over 100 in all), with a handy order form for your convenience.

ADDRESS DEPT. A-661

Allegheny Metal *lasts!* As far as anyone knows, it won't wear out, and it can't wear off because it's solid . . . the same bright, hard, immensely strong metal all the way through. No other metal can match stainless steel in this combination of desirable qualities. So, whether you're thinking about pots and pans, or anything from safety pins up to railroad trains and skyscrapers—remember that Allegheny Metal costs less in the long run because it *lasts* longer, and because it stays beautiful for life with little or no maintenance. ● Let us help *you* use it. ***Allegheny Ludlum Steel Corporation, Oliver Bldg., Pittsburgh 22, Pa.***

Make it BETTER-and LONGER LASTING-with

Allegheny Metal

WAD 52170

Warehouse stocks carried by all Ryerson steel plants

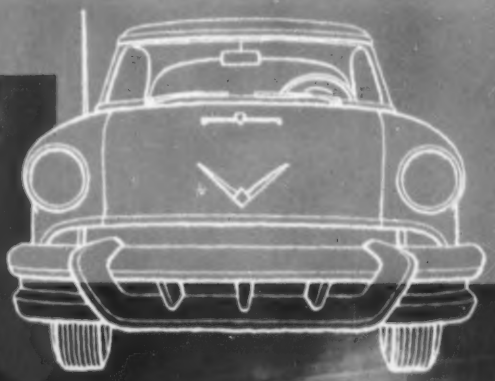
® AL
TIME-TESTED
STAINLESS STEEL

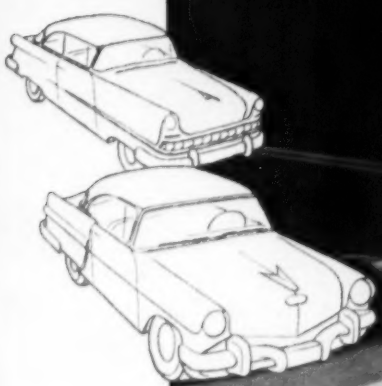
4-HIGH REVERSING

ROUGHING STAND

FOR

HOT STRIP MILL





designed and built by _____

UNITED

ENGINEERING AND FOUNDRY COMPANY

PITTSBURGH, PENNSYLVANIA

Plants at • Pittsburgh • Vandergrift • Youngstown • Canton • Wilmington (Lobdell United Division)

SUBSIDIARIES: Adamson United Company, Akron, Ohio
Stedman Foundry and Machine Company, Inc., Aurora, Indiana

Designers and Builders of Ferrous and Non-Ferrous Rolling Mills, Mill Rolls, Auxiliary Mill and Processing Equipment, Presses and other heavy machinery. Manufacturers of Iron, Nodular Iron and Steel Castings and Weldments.

LUKENS "T-1" STEEL

is the newest in a "Family of Steel Plate Products" which helps the Metalworking Industry to provide better equipment more efficiently

Lukens Steel Company, world's leading producer of specialty steel plate, has been licensed by United States Steel to produce the new "T-1" steel—a unique, low carbon, quenched and tempered alloy plate steel.

This all-purpose steel has a yield strength three times that of ordinary carbon steel, allowing a definite saving by reducing the weight of the finished equipment. "T-1" steel has exceptional toughness and excellent resistance to wear and impact which cuts maintenance and replacement costs, lengthens equipment life. And fabrication is no problem because the material is readily weldable without preheating.

Heat-treated alloy steels, like "T-1" steel, are a specialty at Lukens. We are equipped with the most modern and extensive facilities in the industry to heat treat and finish them. And, they are complemented by the widest range of types and sizes of clad steels available, by the facilities to produce the world's widest and heaviest plates in a full selection of carbon and alloy steel qualities, and by the most complete line of styles and sizes of carbon, alloy and clad steel heads.

All of this adds up to a range of plate products which gives the equipment builder maximum flexibility in selection of materials from one source with all the time and cost economies full order service implies.

Beyond supplying specialty steels and the technical helps in applying them, we believe we also offer a unique plus value in marketing support through marketing, merchandising and commercial research assistance. We even carry this teamwork concept to the degree of actively and continually promoting, for our customers, the economies of modern equipment to all industrial management.

This concept of ourselves as specialists has developed during the 145 years we have been in business as a materials supplier. Today, Lukens is the oldest continuing-line-of-ownership company in the industry. We believe we will continue to hold this record as long as we continue to contribute to your success as an equipment builder.

As one pioneer to another . . .
Lukens salutes The IRON AGE on a century of service to metalworking

LUKENS

LUKENS STEEL COMPANY

Coatesville, Pennsylvania

WORLD'S LEADING PRODUCER OF SPECIALTY STEEL PLATE • CARBON, ALLOY AND CLAD STEELS • HEADS • PLATE SHAPES • FOR QUALIFIED EQUIPMENT BUILDERS

CONNORS

Modern, Integrated Steel-Making Facilities . . . "Sparked" By Superior Service

In addition to its modern, integrated steel-making facilities and central-to-the-South location, Connors has "what it takes" to provide exceptional service in another important way. This third factor is the unusually close-knit teamwork and cooperation between Connors' sales and production people. Both go all out to see that your steel, exactly as specified, arrives when you need it.

It's this traditional "spark" of determination to provide superior service, combined with Connors' physical advantages, that keeps more and more Southern steel users specifying Connors' steel.





CONNORS PRODUCTS:

- Reinforcing Bars
- Merchant Bars
- Structural Shapes
- Hot Rolled Strip
- Studded T Fence Posts
- Highway Sign Posts
- Bulb Tees
- Special Sections

HKP

H. K. PORTER COMPANY INC.

CONNORS STEEL DIVISION

H. K. PORTER COMPANY, INC.
OF PITTSBURGH
P. O. BOX 2562 • BIRMINGHAM, ALA.



The world over, Aetna-Standard is recognized as the leading authority and builder of cold draw equipment for tubes and bars. Most recent innovations . . . air gripper carriages and hooks and 5-tube draw.

AETNA-STANDARD

54 years of designing



This year Aetna will have completed the building of 24 Continuous Galvanising Lines, more than all other manufacturers combined. Aetna has worked closely with industry in this development and is considered the pioneer in continuous coating equipment, including galvanising, terne and electrolytic tinning.

DRAWBENCHES • PIPE MILLS •
ROLLS • CONTINUOUS COATING LINES •
EQUIPMENT FOR PROCESSING SHEET,
STRIP, TIN, RUBBER AND PLASTIC

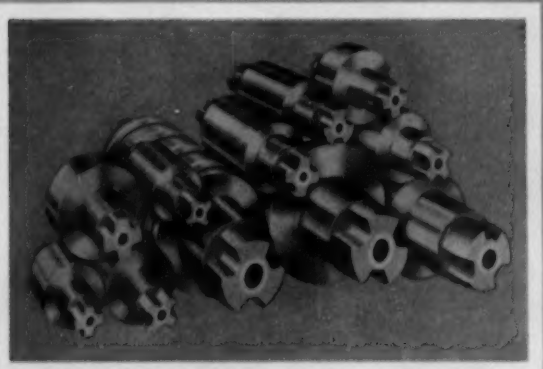


Aetna-Standard designs and manufactures a complete line of equipment for processing flat-rolled products.



In both Seamless Tube Mills and Continuous Butt Weld Pipe Mills, Aetna-Standard ranks as the leader in design and manufacture.

and building equipment . . .



Aetna-Standard specializes in manufacture of small and medium-sized iron-base rolls, pioneering in the use of Nodular Iron Rolls and Castings under the trade name of Magaloy.



In rubber and plastic, Aetna-Standard designs and manufactures basic equipment. Illustrated is the new Aetna Process Laboratory for development of processes and machines for rubber and plastic.

SUBSIDIARY and ASSOCIATED COMPANIES

The Aetna-Standard Engineering of Canada, Ltd., Toronto, Ontario, Canada.
The Head Wrightson Machine Company, Ltd., Middlesbrough, Eng.
Societe de Constructions de Montbard, Montbard, France.
Demag Aktiengesellschaft, Duisburg, Germany.
Compagnia Italiana Forme Acciaio, Milano, Italy.
Aetna-Japan Company, Ltd., Tokyo, Japan.
Engineering and Development Corporation of the Philippines, Manila, P. I.
Hale and Kuligren, Inc., Akron, Ohio.
M. Castellvi, Inc., New York, N. Y.
Standard Engineering Co., Ellwood City, Pa.
Trans-World Traders, Inc., Pittsburgh, Pa.

Designers and Builders to the Steel, Copper, Brass, Aluminum, Rubber, Plastic and Chemical Industries

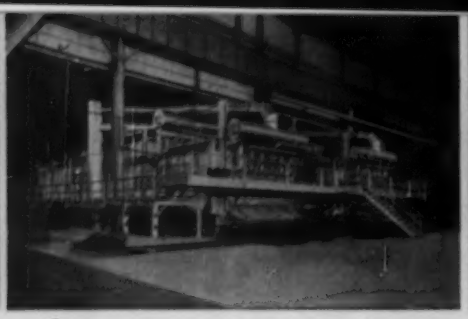
THE AETNA-STANDARD ENGINEERING COMPANY • PITTSBURGH, PA.

Aetna-Standard

PLANTS IN WARREN, OHIO • ELLWOOD CITY, PENNSYLVANIA



1 One-way fired recuperative soaking pits.



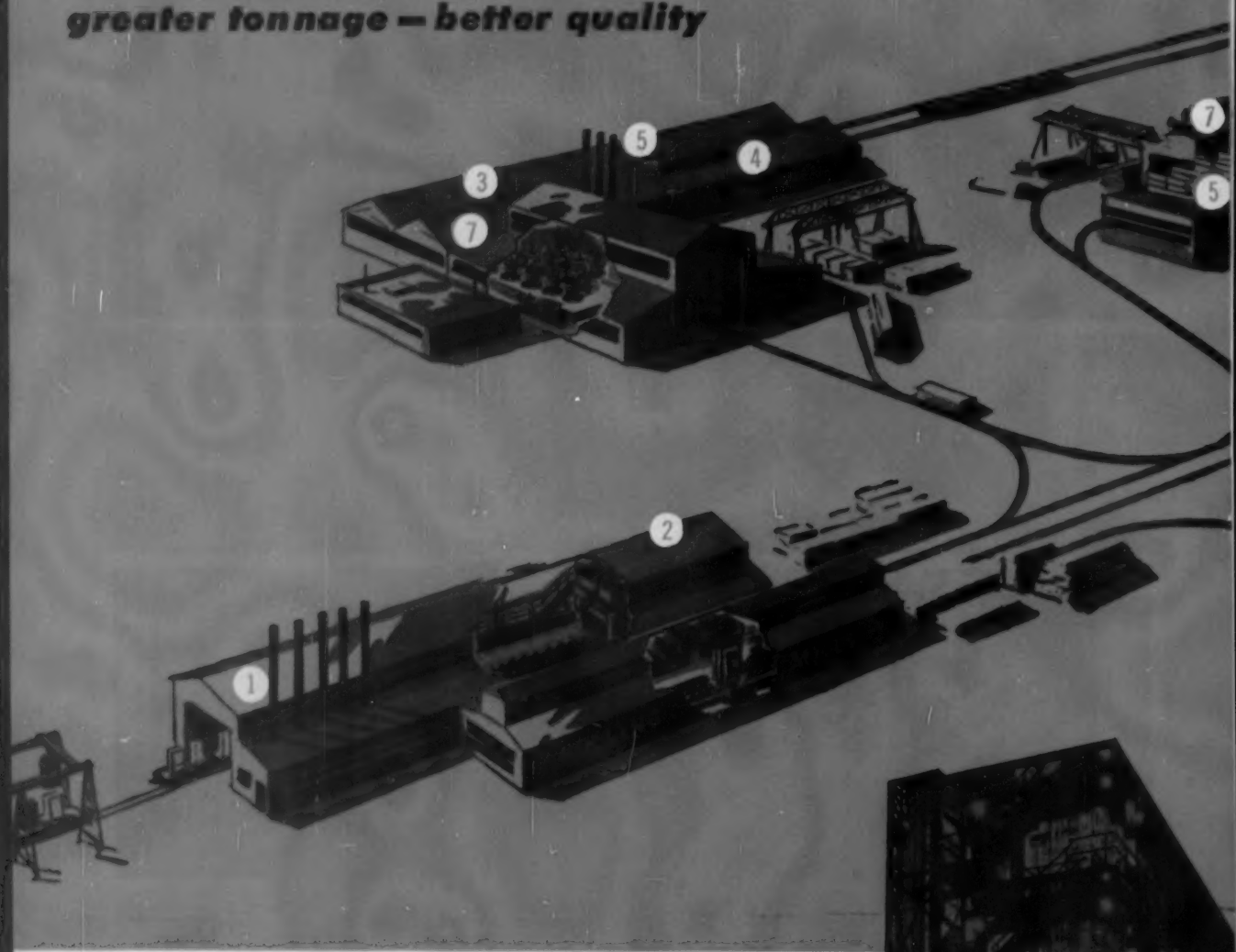
2 Continuous slab and billet furnaces.



3 Continuous wire patenting furnaces.

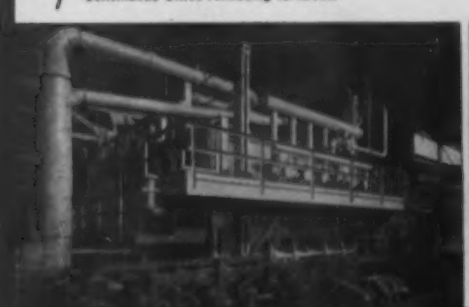
DIVIDENDS DECLARED DAILY

greater tonnage — better quality



7 Continuous billet reheating furnaces.

8 Controlled atmosphere coil annealing covers.





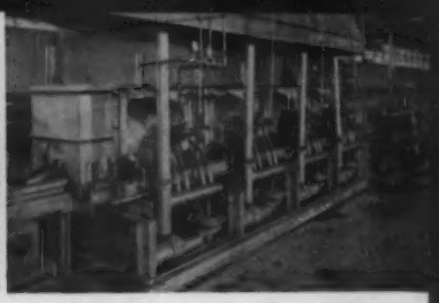




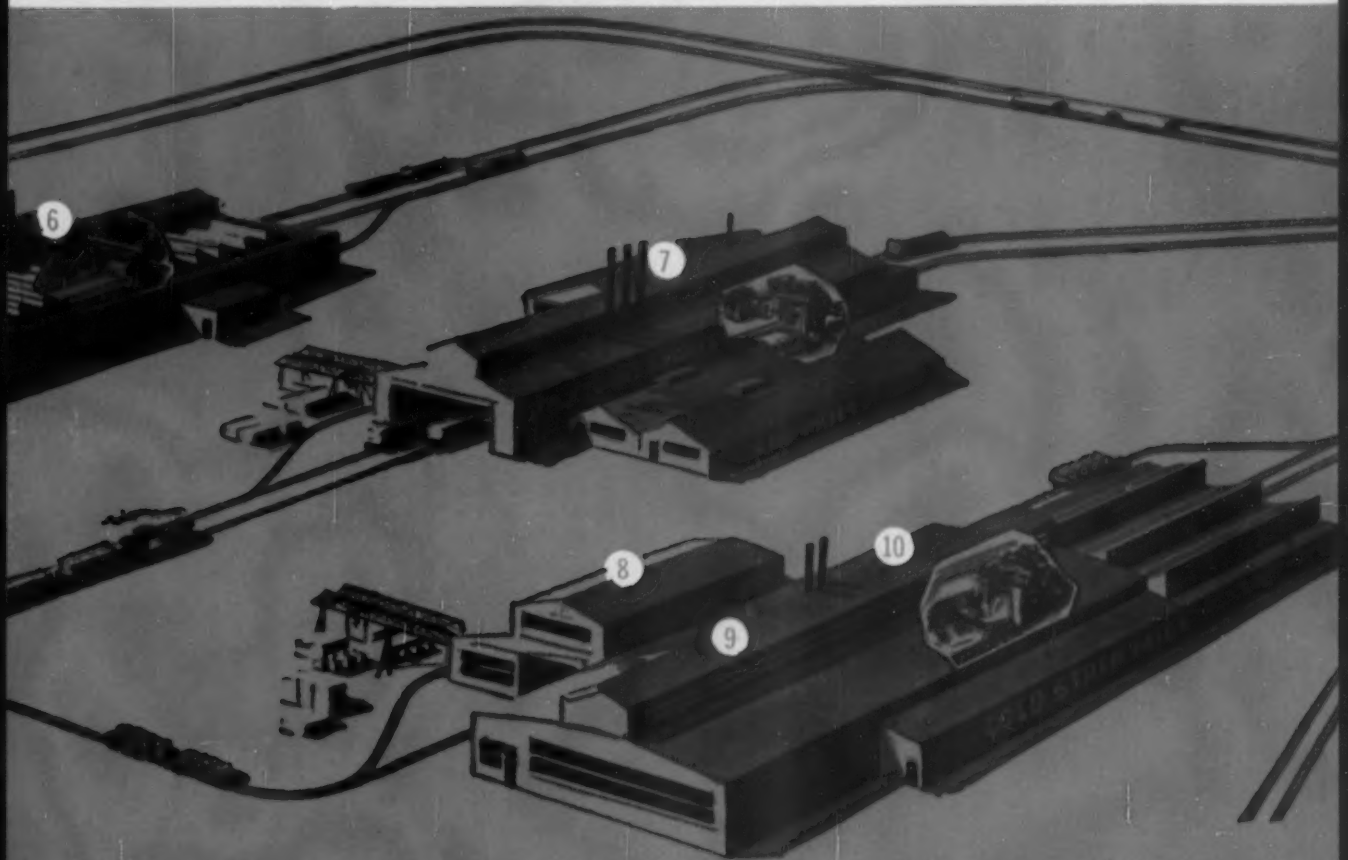
4 Pit type rod annealing furnaces.



5 Continuous roller hearth controlled atmosphere carbon restoration and annealing furnaces.



6 High-speed stress relief furnaces for steel tubing.



Wherever you look in steel mills today, you can find Surface Combustion equipment declaring daily dividends in greater tonnage and precise quality control. These are dividends returned to the customer from 50 years of research, development, and experience in heating and handling steel.

'Surface' furnaces, soaking pits, annealing covers and controlled atmosphere generators have been specified time after time for postwar modernization by steelmen who expect their equipment investments to be gilt-edge securities.

If you are planning an investment in steel mill furnace equipment, put it where it will return dividends every day—in equipment built by 'Surface'.

9 Continuous strip annealing furnaces for tin plate.

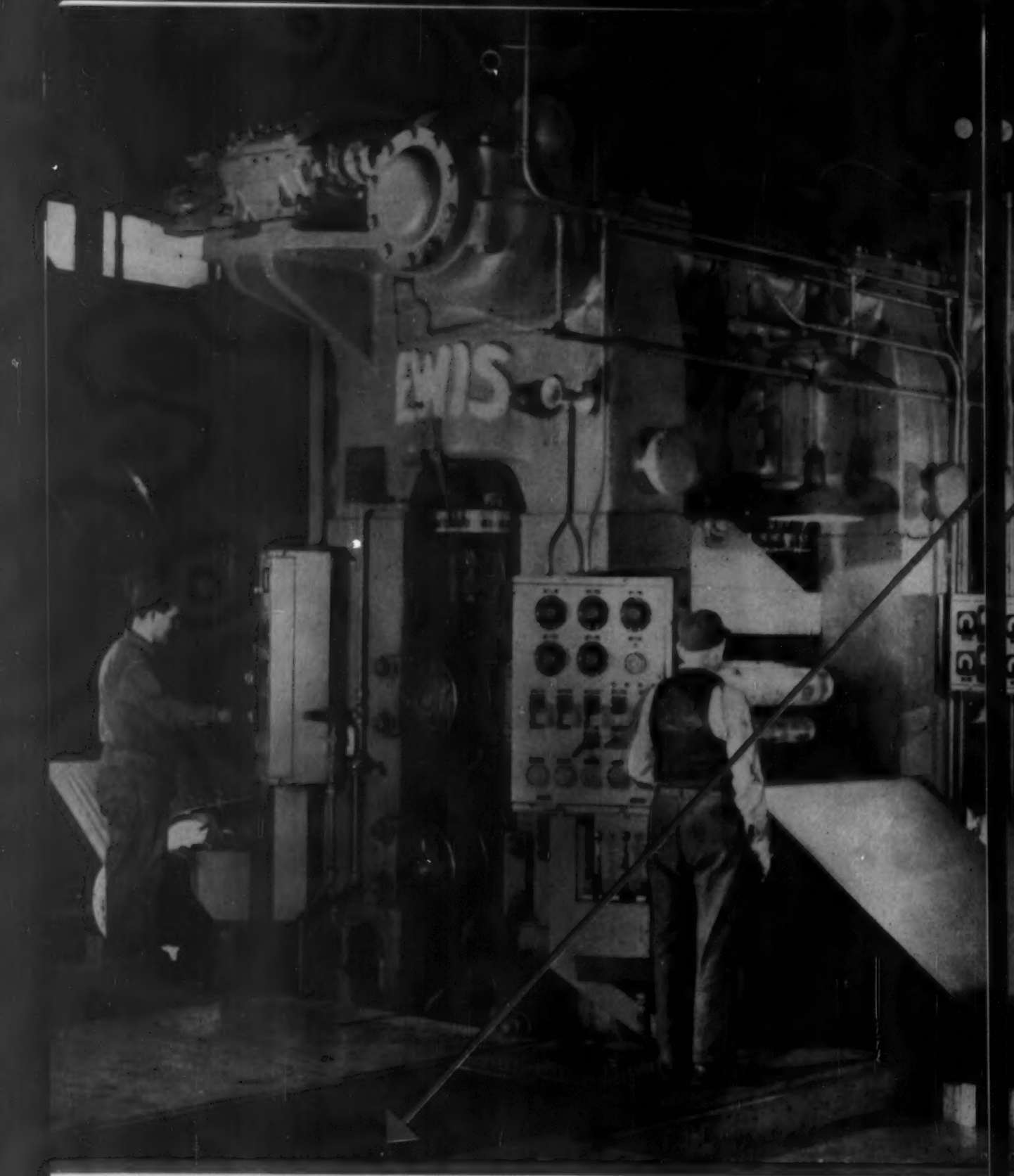


Foreign affiliate companies:

British Furnaces, Ltd., Chesterfield
Stein & Atkinson, Ltd., London
Stein & Roubaix, Paris, Liege, and Genoa
Benno Schilde Maschinenbau, A.G., Bad Hersfeld (Hessen, Germany)
Chugai Ro Kogyo Kaisha, Ltd., Osaka

Surface
STEEL MILL FURNACES

SURFACE COMBUSTION CORP. • TOLEDO 1, OHIO



new **LEWIS** two-high skin pass **MILL**

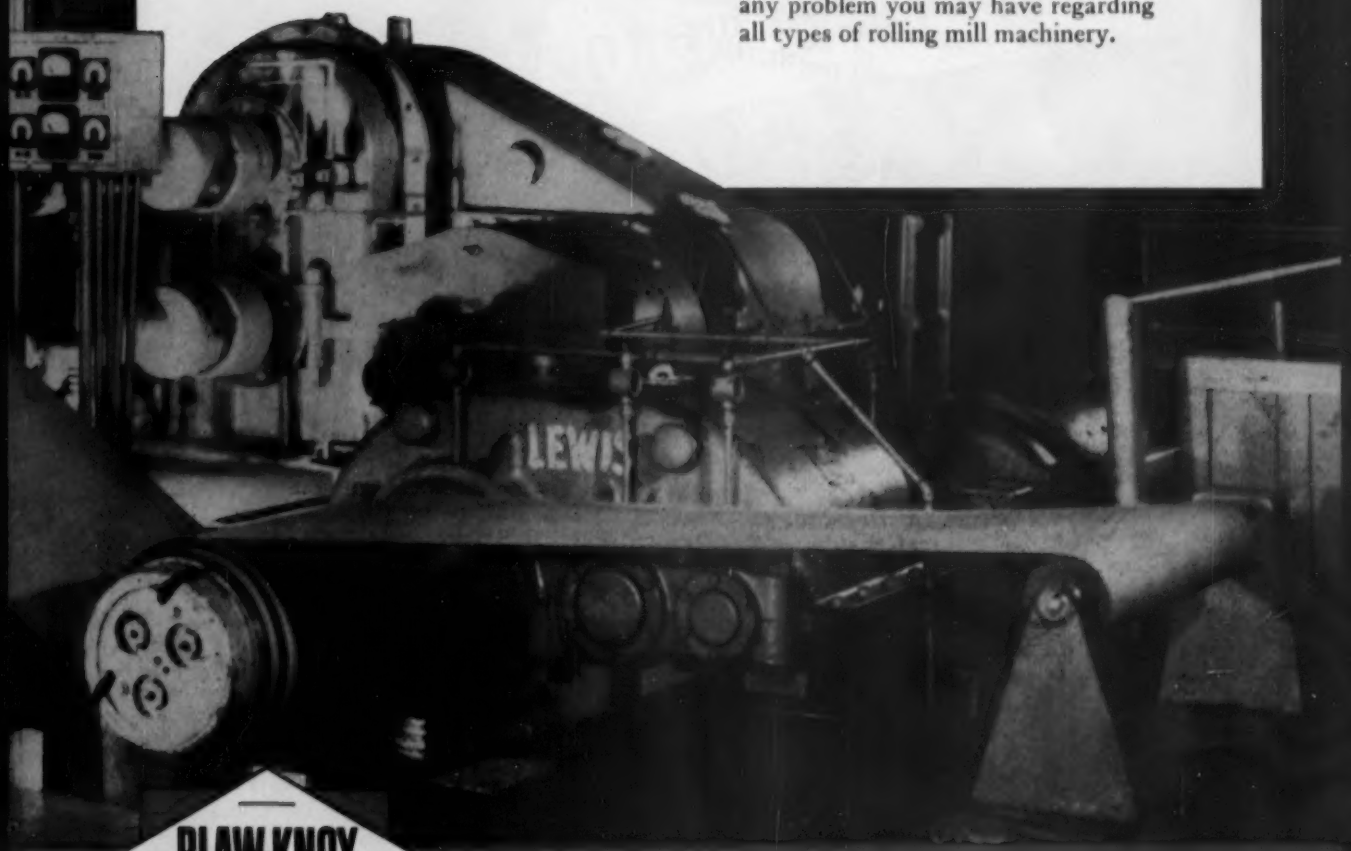
. . . rolls out quality strip of uniform, accurate gauge and high lustre finish

In line with the industry's need for modern, versatile machines to improve quality and increase production, our engineers recently designed and built the Lewis two-high, skin pass Mill.

This new mill operates to very close tolerances, at speeds from 150 to 300 feet per minute on stainless steel. Already built and operating in 28"x42" and 28"x56" sizes. Other units, using the same basic design, can be built in sizes to handle the full range of widths and gauges—to meet your particular requirements.

At any time, we will be pleased to give you more complete information about the design and performance of this new Lewis two-high, skin pass Mill.

And, of course, our experienced engineers and our manufacturing facilities are always available to help you solve any problem you may have regarding all types of rolling mill machinery.



BLAW-KNOX

BLAW-KNOX COMPANY • LEWIS MACHINERY DIVISION
PITTSBURGH 22, PENNSYLVANIA

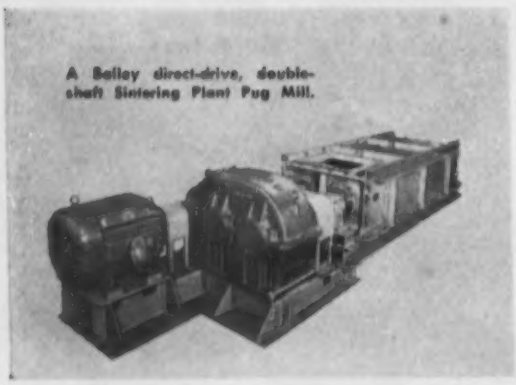
Lewis Products: Two-High Mills • Three-High Mills • Four-High Mills • Bar and Billet Mills • Rod Mills • Coilers • Tables • Shears • Levelers • Pinion Stands • Gear Drives • Roll Lathes • Flaking Mills • and all types of auxiliary mill equipment

SINTERING PLANT

Bailey PUG MILLS



This was the first Bailey Pug Mill, installed in 1930. It still operates efficiently today, and even the original bearings still are in service.



A Bailey direct-drive, double-shaft Sintering Plant Pug Mill.

These mills are built for continuous service and for the low-cost processing of greater tonnages of more uniform sintered products. Bailey Pug Mills have capacities ranging from 100 to 400 tons per hour. They are made in single and double shaft models, with direct or rope drives. *Write for bulletin.*

REPRESENTATIVE BAILEY PUG MILLS USERS	Number of Mills
Bethlehem Steel Company	5
Jones & Laughlin Steel Corporation	2
United States Steel Corporation	13
Youngstown Sheet & Tube Company	3

WILLIAM M. Bailey COMPANY
ENGINEERS
LEADERSHIP THROUGH QUALITY
1221 BANKSVILLE ROAD PITTSBURGH 16, PA



They used to tell you where you could go when you asked for certain sizes and lengths in heavy-wall seamless tubing. Usually, where you had to go was Europe!

Not any more. Barium cocked a knowing eye at the situation, built a rotary forging seamless tube mill in Phoenixville, Pa., for its member company, Phoenix Iron & Steel Co. ("Step-ahead" thinking like this, by the way, accounts for Barium's notable growth record in the past few years.)

We underline "fast delivery" in the headline because this new mill is specifically designed for *fast change-over* from one size and type of heavy-wall tubing to another.

Now U.S. industry can count on Phoenix for "home-grown" heavy-wall seamless tubing in the special types required to handle today's higher pressures and temperatures in power and process plants as well as oilfield deep-drilling. For more facts about this new mill — or for "The Barium Story" — write to Barium Steel Corporation, 25 Broad St., New York, N.Y. 5.4

16 INTEGRATED COMPANIES
BARIUM
STEEL CORPORATION
WORKING IN STEEL, ALUMINUM, MAGNESIUM, FIBERGLASS

Steel Producers
Chester Blast Furnace (pig iron) • Central Iron and Steel Company • Phoenix Iron & Steel Company

Steel Fabricators & Processors
Phoenix Bridge Co. • Industrial Forge & Steel, Inc. • Globe Forge, Incorporated • Geometric Stamping Co.

Manufacturers of End Products
Clyde Iron Works, Inc. • Erie Bolt and Nut Company • Bayonne Bolt Corp. • Cuyahoga Spring Company • Jacobs Aircraft Engine Co. • Kermath Manufacturing Company • Kermath Limited (Canada) • Wiley Manufacturing Co.

Lightweight Metal and Plastics
East Coast Aeronautics, Inc.

ELECTROMET

TRADE-MARK

ALLOYS FOR THE STEEL, IRON, AND NON-FERROUS INDUSTRIES

BORON ALLOYS

Ferroboron Min. 10.00% Boron Grade	Aluminum ...max. 0.50% Carbon .....max. 1.50%	Increases hardenability of steel; also, for additions to malleable iron and aluminum alloys.
Min. 17.50% Boron Grade	Aluminum ...max. 0.50% Carbon .....max. 0.50%	
Manganese-Boron	Boron .....min. 17.50% Manganese ..approx. 75% Carbon .....max. 3% Iron .....max. 5%	Used to cleanse and deoxidize non-ferrous alloys.

CALCIUM ALLOYS

Calcium-Silicon	Calcium .....30 to 33% Silicon .....60 to 65% Iron .....1.50 to 3%	Deoxidizer for quality ingot steel. Also used in high-tensile gray irons.
Calcium-Manganese-Silicon	Calcium .....16 to 20% Manganese ...14 to 18% Silicon .....53 to 59%	A complex deoxidizer used widely in production of steel castings.
Calcium Metal Regular Grade	Calcium .....98% Balance largely Calcium Chloride	Reducing agent in metallurgical applications, deoxidizer and degasifier for non-ferrous metals.
Distilled Grade	Calcium..approx. 99.50% Balance largely Magnesium	For special applications requiring calcium of very high purity.

CHROMIUM ALLOYS

"Simplex" Low-Carbon Ferrochrome No. 1	Chromium ....63 to 66% Silicon .....5 to 7% Carbon ....max. 0.010% or 0.025%	For producing stainless steel, particularly the very low-carbon grades. The silicon in the alloy reduces metal oxides from the slag back into the bath. Rapid solubility of the alloy saves furnace time. "Simplex ferrochrome No. 2 is suitable for producing stainless steel where high silicon is not desirable.
2% Nitrogen-Bearing Grade	Chromium ....62 to 65% Silicon .....5 to 7% Nitrogen .....2 to 2.5% Carbon ....max. 0.025%	
5% Nitrogen-Bearing Grade	Chromium ....60 to 63% Silicon .....5 to 7% Nitrogen .....5 to 6% Carbon ....max. 0.025%	
"Simplex" Low-Carbon Ferrochrome No. 2	Chromium ....63 to 66% Silicon .....max. 1.50% Carbon .....max. 0.03%	
2% Nitrogen-Bearing Grade	Chromium ....62 to 65% Silicon .....max. 1.50% Nitrogen .....2 to 2.5% Carbon .....max. 0.03%	
5% Nitrogen-Bearing Grade	Chromium ....60 to 63% Silicon .....max. 1.50% Nitrogen .....5 to 6% Carbon .....max. 0.03%	
Low-Carbon Ferrochrome (Other Grades)	Chromium ....67 to 71% Silicon ...0.30 to 1.00% Carbon (10 Grades) max. 0.02 to max. 2.00%	Production of stainless steels and high-temperature alloys requiring low carbon content.
High-Carbon Ferrochrome Max. 3.00% Carbon Grade	Chromium ....60 to 65% Silicon .....max. 2%	For production of stainless steel, as well as engineering alloy steels and other alloy steels.
Max. 4.50, 5.00, or 6.00% Carbon Grade	Chromium ....67 to 70% Silicon .....1 to 2%	
Max. 7.00% Carbon Grade	Chromium ....66 to 69% Silicon .....1 to 3%	
Min. 7.00% Carbon Grade	Chromium ....65 to 68% Silicon .....1 to 3%	
57 to 65% Chromium Grade	Carbon ....max. 5 or 6% Silicon ...max. 3.5 or 4%	
Nitrogen-Bearing Low-Carbon Ferrochrome	Chromium ....65 to 70% Silicon ...0.30 to 1.00% Carbon .....max. 0.10% Nitrogen ..0.75 to 2.00%	For additions of nitrogen to improve properties of high-chromium steels.
"SM" Ferrochrome	Chromium ....60 to 65% Silicon .....4 to 6% Carbon .....4 to 6% Manganese ....4 to 6%	A high-solubility chromium addition for steel or iron in either furnace or ladle.

CHROMIUM ALLOYS cont.

Exothermic Ferrochrome 5	Chromium ..approx. 50% Carbon ....approx. 2.5%	These improved exothermic ladle alloys have high solubility, low carbon pickup, and high ignition temperature.
Exothermic Ferrochrome 8	Chromium ..approx. 48% Carbon .....approx. 4%	
Exothermic Silicon-Chrome	Chromium ..approx. 46% Silicon .....approx. 23% Carbon .....max. 1.00%	
Foundry Ferrochrome High-Carbon Grade	Chromium ....62 to 66% Silicon .....7 to 10% Carbon .....5 to 7%	Developed especially for high-solubility ladle additions of chromium to improve composition and properties of cast iron.
Low-Carbon Grade	Chromium ....50 to 54% Silicon .....28 to 32% Carbon .....max. 1.25%	
Chromium Metal High-Carbon Grade	Chromium ....87 to 90% Carbon .....9 to 11% Iron .....max. 1.25%	Production of wide variety of non-ferrous chromium-bearing alloys, including electrical resistance alloys and high-temperature alloys.
Electrolytic Grades Laboratory Grade	Chromium ..min. 99.20% Iron .....max. 0.03%	
Commercial Grade	Chromium ..min. 99.00% Iron .....max. 0.30%	
"EM" Ferrochrome-Silicon	Chromium ....39 to 41% Silicon .....42 to 46% Carbon .....max. 0.05%	Used in production of stainless steel to reduce metal oxides from the slag back into bath.
"EM" Ferrosilicon-Chrome	Chromium ....50 to 54% Silicon .....28 to 32% Carbon .....max. 1.25%	For adding chromium and silicon to steels containing up to 1 or 2 per cent chromium.
"EM" Chromium Briquets (Hexagonal Shape)	Chromium .....2 lb. Total Weight .....3⅜ lb.	For adding chromium to cast iron in the cupola.

COLUMBIUM ALLOYS

Ferrocolumbium	Columbium ...50 to 60% Silicon .....max. 8% Carbon .....max. 0.40%	Stabilizer in austenitic chromium-nickel stainless steels. Also constituent of high-temperature alloys.
Ferrotantalum-Columbium	Columbium ..approx. 40% Tantalum ...approx. 20% Cb + Ta .....min. 60% Carbon .....max. 0.30% Iron .....approx. 25%	Used to supplement ferrocolumbium in chromium-nickel stainless steels and high-temperature alloys.

MANGANESE ALLOYS

Standard Ferromanganese Regular Grade	Manganese ...74 to 76% Carbon .....approx. 7% Silicon .....max. 1%	Most common means of adding manganese to steel for both alloying and deoxidizing purposes. Also for counteracting sulphur in steel and cast iron.
Low-Phosphorus Grade	Manganese ...78 to 80% Carbon .....max. 7% Silicon .....max. 2% Phosphorus ..max. 0.10%	
Low-Carbon Ferromanganese Low-Phosphorus Grade	Manganese ....min. 90% Carbon .....max. 0.07% Phosphorus ..max. 0.06%	Additions of manganese to steels of low-carbon specification, particularly stainless steels of 18 per cent chromium, 8 per cent nickel type.
Regular Grades	Manganese ...85 to 90% Carbon ..max. 0.07, 0.10, 0.15, 0.30 or 0.50%	
Regular Grade (High-Silicon)	Manganese ...80 to 85% Carbon .....max. 0.75% Silicon .....5 to 7%	
"Mansiley" Alloy	Manganese ...60 to 63% Silicon .....28 to 31% Carbon .....max. 0.07% Phosphorus ..max. 0.05%	Used in production of stainless steels to reduce metal oxides from the slag back into the bath.
Silicomanganese Max. 1.50% Carbon Grade	Manganese ...65 to 68% Silicon .....18 to 20%	A versatile alloy useful as furnace block, deoxidizer, and also for making manganese additions to steel in the ladle or in the furnace.
Max. 2.00% Carbon Grade	Manganese ...65 to 68% Silicon ....15 to 17.50%	
Max. 3.00% Carbon Grade	Manganese ...65 to 68% Silicon ....12 to 14.50%	

All of the alloys and metals listed are produced in the usual lump, crushed, or ground sizes, except where other special forms are indicated.

MANGANESE ALLOYS cont.

Medium-Carbon Ferromanganese	Manganese ...80 to 85% Carbon ...1.25 to 1.50% Silicon.max. 1.00 or 1.50%	For making low- and medium-carbon manganese steel and Hadfield steel.
Low-Iron Ferromanganese	Manganese ...85 to 90% Carbon ...approx. 7.00% Silicon .....max. 3% Iron .....max. 2%	For high manganese additions to certain non-ferrous alloys, particularly aluminum.
Manganese Metal Electrolytic Grade	Manganese .min. 99.90%	Used wherever manganese of high purity is required in the production of stainless steel and non-ferrous alloys.
Nitrogen-Bearing Grade	Manganese ..approx. 93% Nitrogen ....approx. 6%	
"EM" Silico-manganese Briquets (Square Shape)	Manganese .....2 lb. Silicon .....½ lb. Total Weight .....3½ lb.	For adding manganese (with silicon) to cast iron in the cupola.
"EM" Ferro-manganese Briquets (Oblong Shape)	Manganese .....2 lb. Total Weight .....3 lb.	For adding manganese (without silicon) to cast iron in the cupola.

SILICON ALLOYS

50% Ferrosilicon		
Regular Grade	Silicon .....47 to 51%	Deoxidizer for most grades of killed or semi-killed steel. Blocking grade specially sized for maximum efficiency.
Blocking Grade	Silicon .....47 to 51%	
Boron-Bearing Grade	Silicon .....47 to 51% Boron ....0.04 to 0.05%	
Low-Aluminum Grade	Silicon .....47 to 51% Aluminum ...max. 0.40% or 0.10%	
65% Ferrosilicon		
Regular Grade	Silicon .....65 to 70%	For furnace or ladle addition to steels.
Low-Impurity Grade	Silicon ..61.50 to 66.50% Aluminum ...max. 0.50% Total Impurities max. 1.00%	Mainly for production of electrical sheet steel.
75% Ferrosilicon		
Regular Grade	Silicon .....73 to 78%	Deoxidizer and alloy for production of high-silicon spring and electrical sheet steel. Graphitizing inoculant for cast iron.
Low-Aluminum Grade	Silicon .....73 to 78% Aluminum ...max. 0.50%	
85% Ferrosilicon		
Regular Grade	Silicon .....83 to 88%	Enables melter to add higher percentages of silicon without chilling metal in ladle. Graphitizing inoculant for cast iron.
Calcium-Bearing Grade	Silicon .....83 to 88% Calcium ....min. 0.50%	
Low-Aluminum Grade	Silicon .....83 to 88% Aluminum ...max. 0.50%	
90% Ferrosilicon		
Regular Grade	Silicon .....92 to 95%	Permits large additions of silicon without harmful chilling effect.
Low-Aluminum Grade	Silicon .....92 to 95% Aluminum ...max. 0.50%	
Silicon Metal		
Regular Grade	Silicon ...min. 97 or 96% Iron .....max. 1 or 2%	Additions of silicon to non-ferrous metals, particularly aluminum and copper.
Purified Grade	Silicon ..99.70 to 99.90% Iron .....005 to .015%	For applications in non-ferrous industry requiring silicon of high purity.
Low-Calcium Grade	Silicon .....min. 97% Iron .....max. 1% Calcium .....max. 0.10%	For high-silicon aluminum alloys where calcium is detrimental.
Low-Aluminum Grade	Silicon .....min. 98% Iron .....max. 1% Aluminum ...max. 0.10%	For the production of silicon-copper alloys where aluminum is detrimental.
"EM" Silicon Briquets		
Large Size (Cylindrical or Brick-Shape)	Silicon .....2 lb. Total Weight .....5 lb.	For adding silicon to cast iron in the cupola.
Small Size (Cylindrical Shape)	Silicon .....1 lb. Total Weight .....2½ lb.	

SILICON ALLOYS cont.

"SMZ" Alloy	Silicon .....60 to 65% Manganese ....5 to 7% Zirconium .....5 to 7%	Particularly strong graphitizing inoculant used in cast iron.
Magnesium-Ferrosilicon		
Regular Grade	Silicon .....43 to 47% Magnesium ..7.5 to 9.5%	For addition to cast iron and steel to obtain special properties.
Cerium-Bearing Grade	Cerium ...approx. 0.50%	

TITANIUM ALLOYS

Ferrotitanium	Titanium ..27 to 32%, 50 to 55%, or approx. 70% Carbon .....max. 0.10%	For stabilized stainless steels and high-temperature metals.
Silicon-Titanium	Titanium .....40 to 50% Silicon .....45 to 50% Iron .....max. 3%	For additions of titanium to steels or non-ferrous alloys.
Manganese-Nickel-Titanium	Titanium ...approx. 48% Nickel .....approx. 31% Manganese .approx. 6%	Deoxidization of nickel alloys.

TUNGSTEN ALLOYS

Ferrotungsten	Conforming to A.S.T.M. Spec. A 144-50	Production of tool and die steels; also high-temperature alloys.
Tungsten Metal Powder		
Melting Grade	Tungsten ...min. 98.80% Total Carbon..max. 0.25%	Production of tungsten steels and cast tungsten carbide.
Calcium Tungstate	Tungstic Oxide .68 to 72%	For making tungsten chemicals and other tungsten products.
Calcium Tungstate Nuggets	Tungstic Oxide .68 to 72%	Making tool steels and high-temperature alloys.
Ammonium Paratungstate	Tungstic Oxide.min. 88.7%	Intermediate for tungsten products.

VANADIUM ALLOYS

Ferrovanadium	Vanadium ....50 to 55% or 70 to 75% Carbon ..max. 0.20, 0.50, or 3.00% Silicon ..max. 1.50, 2.00, or 8%; and approx. 10%	Production of tool and engineering steels, high-strength structural steels, non-aging rimming steels, and wear-resistant irons.
Vanadium Oxide Fused	V_2O_5 .....86 to 89% Na_2O .....approx. 10% CaO .....approx. 2%	For addition of vanadium to steel and for manufacturing catalysts.
Sodium Polyvanadate (Red Cake)	V_2O_5 .....approx. 85% Na_2O .....approx. 9%	
High-Purity	V_2O_5 ....approx. 99.50%	For manufacture of vanadium compounds, including vanadium catalysts.
Ammonium Metavanadate	NH_4VO_3 .....min. 99%	

ZIRCONIUM ALLOYS

12 to 15% Zirconium Alloy	Zirconium ....12 to 15% Silicon .....39 to 43% Carbon .....max. 0.20%	A powerful deoxidizer. Also increases depth of hardening of steel.
35 to 40% Zirconium Alloy	Zirconium ....35 to 40% Silicon .....47 to 52% Carbon .....max. 0.50%	Deoxidizer for fine grades of alloy steels.
"EM" Zirconium Briquets (Cylindrical Shape, Reddish Color)	Zirconium .....0.55 lb. Silicon .....1.90 lb. Total Weight .....5 lb.	For adding zirconium and silicon to cast iron in the cupola.

"Electromet," "EM," "Monsilloy," "Simplex," "SM," and "SMZ," are trade-marks of Union Carbide and Carbon Corporation.

IF YOU HAVE A METALS PROBLEM

More than 50 different alloys and metals are produced by ELECTROMET. If you need help in selecting the proper alloys, be sure to consult one of ELECTROMET'S specially trained metallurgists and engineers. Address your inquiries to one of the offices listed at right.

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Detroit 21, Mich.....10421 West Seven Mile Road
Houston 11, Texas.....6119 Harrisburg Boulevard
Los Angeles 58, Calif.....2770 Leonis Boulevard
New York 17, N. Y.....30 East 42nd Street
Pittsburgh 22, Pa.....Oliver Building
San Francisco 6, Calif.....22 Battery Street
In Canada: Electro Metallurgical Company, Division of Union Carbide Canada Limited, Welland, Ontario

ELECTRO METALLURGICAL COMPANY A Division of Union Carbide and Carbon Corporation
30 East 42nd Street UCC New York 17, N. Y.



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Kaiser Steel—as a 13-year-old member of an industry so basic to the economy of this nation—salutes the publication which has recorded metalworking progress for a century—*Iron Age*.

Kaiser Steel

built to serve the West



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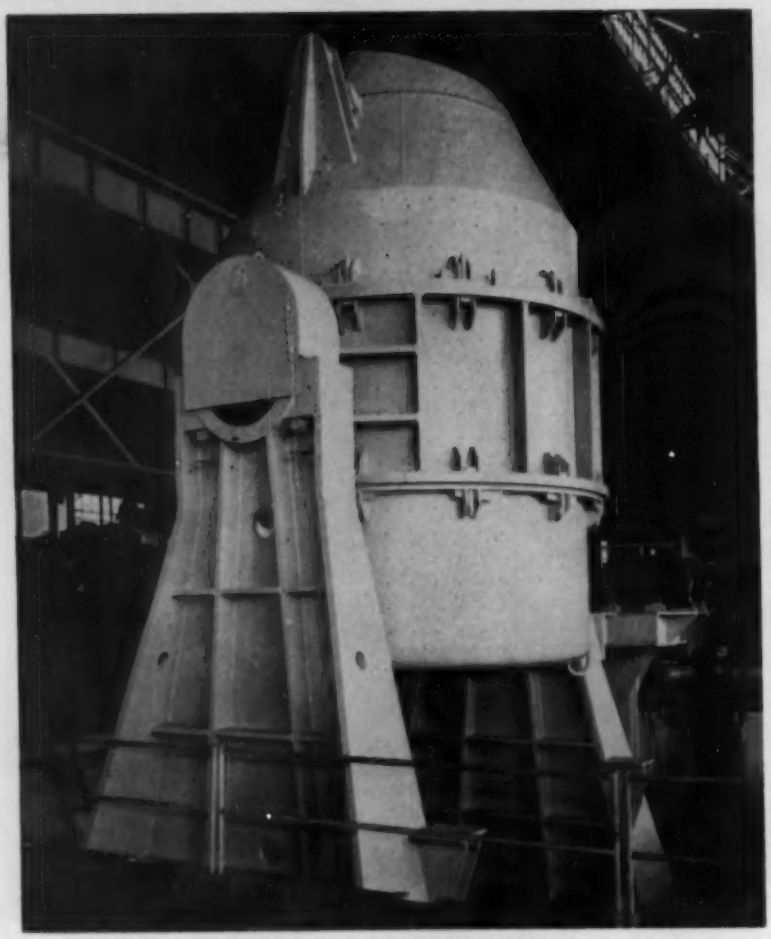
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J&L STEEL

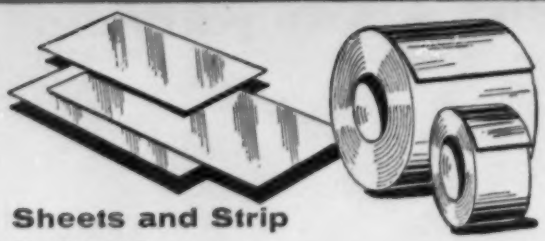
See following pages for list of J & L Carbon Steels

Jones & Laughlin

STEEL CORPORATION — *Pittsburgh*

J&L STEEL

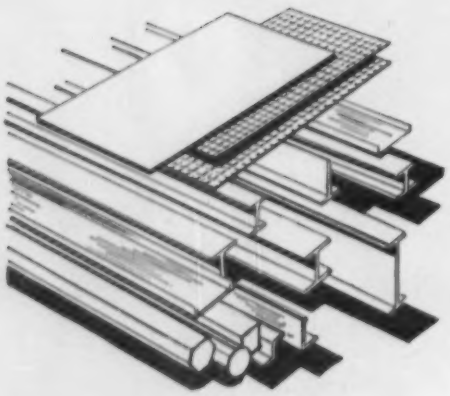
CARBON



Sheets and Strip

- Hot Rolled Sheets
- Hot Rolled Sheets, Pickled and Oiled
- Cold Rolled Sheets
- Cold Rolled Strip
- Cold Rolled Circles

} In Coils or Cut Lengths



Hot Rolled Products

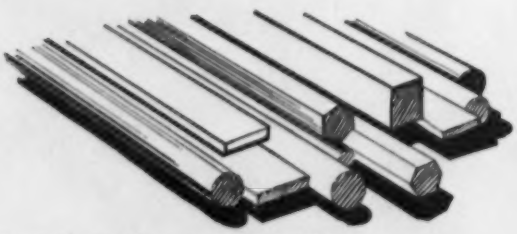
Skelp

Floor Plates—
Jal-Tread and
Junior Jal-Tread
Pattern

Plates

Bars and Small Shapes
Rounds
Squares
Hexagons
Flats
Angles
} In Standard Steel Grades

Special Sections
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Concrete Reinforcing Bars—Straight, Bent, and Fabricated



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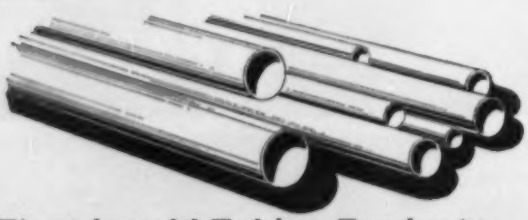
Bars and Shapes
Rounds
Squares
Hexagons
Flats

Cold Drawn special sections—all grades and sizes

Forgings—Turned and Finished

Shafting
Ground and Polished from Cold Drawn Bars
Turned, Ground and Polished
Turned and Polished

Cold Drawn Butt-Welded Tubing



Structural Shapes

Angles
Beams
Channels
Junior Beams
Junior Channels
Junior Tees

Jaltruss Sections

Railroad Track Fasteners
Railroad Spikes

Forgings
Plain Rounds and Squares

Electricweld Tubing Products

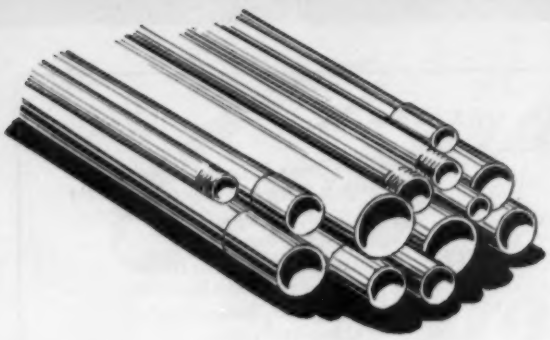
Straight Mechanical Tubing

Cold Drawn Mechanical Tubing

Steel Condenser and Heat Exchanger Tubing

Fabricated Tubing
Perma-Tube
Other Special Fabrications

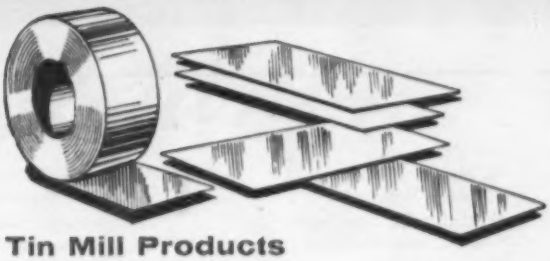
STEELS



Tubular Products

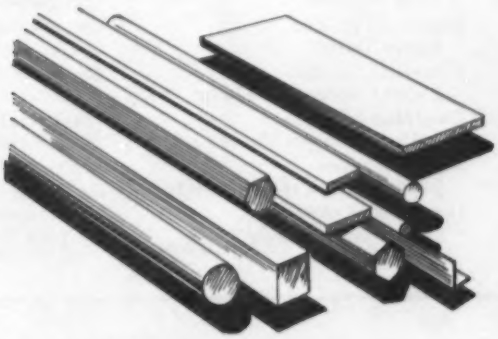
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Jones & Laughlin
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HOT WORK STEELS • HIGH TEMPERATURE ALLOYS

Latrobe

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Brooks lubrication engineering—constant research in the laboratory and "on the job" has been devoted exclusively to the development of industrial lubricants. The wealth of experience and knowledge gained through solving the "tough" lubrication jobs of industry during the past seventy-nine years has resulted in a dependable extreme pressure lead base compound known throughout industry as "Leadolene Klingfast." Hundreds of case studies prove that it lowers lubrication costs and increases service life of equipment. We suggest you try it for trouble-free, economical lubrication of the following:

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LEADOLENE

Klingfast

Write for your copy of "The Brooks Oil Story!"



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Since 1876

PITTSBURGH 12, PA.

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Characteristics of LEADOLENE KLINGFAST

pH-ilm Strength . . . 50,000 psi minimum.
Adhesiveness . . . Affinity for metal develops maximum adhesion providing permanent coating on gears.
Water Repellence . . . Effectiveness is not reduced by water.
Corrosion Prevention . . . Never acidic and will not etch or corrode.
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Low Temperature Factors . . . Does not harden, crack or decrease in adhesion.
Abrasive Resistance . . . Repellent to adhesion of scale, metallics and other contamination.



TO BENEFIT USERS OF ALL SANDVIK PRODUCTS

The new Sandvik building provides modern, expanded facilities for the *administrative, production* and *Eastern Warehouse* operations of the main company and all divisions, including:

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SANDVIK STEEL BELT CONVEYORS

Cold rolled Carbon and Stainless Steel Belt Conveyors for Material Handling and Processing.

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High Quality Swedish Hardware, Tools and Specialties.

Works: Sandviken, Sweden • Hallefors, Sweden

Sandvik Quality Steels

SS-107

For applications which require HIGH FATIGUE LIFE, FINE SURFACE FINISH, ACCURATE & UNIFORM GAUGE specify SANDVIK cold rolled specialty strip steels.

You can get Sandvik strip steels:

- In special analyses for specific applications.
- Precision-rolled in thicknesses to fit your requirements.
- In straight carbon and alloy grades.
- Annealed, unannealed or hardened and tempered.
- Polished bright, yellow or blue.
- With square, round or dressed edges.
- Wide range of sizes in stock— —or slit to your specifications

Ask your nearest Sandvik office for further information or technical assistance.

Sandvik Swedish Specialty Strip Steels are used for Textile Machine Parts such as sinkers, needles, etc. • Band Saws (metal, wood and butcher) • Camera Shutters • Clock and Watch Springs • Compressor Valves • Doctor Blades • Feeler Gauges • Knives such as cigarette knives, surgical, etc. • Razor Blades • Shock Absorbers • A Wide Variety of Springs • Trowels • Reeds: Vibrator, Textile, etc. • Piston Ring Segment and Expanders • and many other applications.

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OIL LEAKAGE MEANS:
higher lubrication costs
messy machines
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SUNTAC OIL:
cuts leakage
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In addition to its leak reducing properties, Suntac has all the high quality of expensive general-purpose oils. Suntac is fortified against oxidation to assure long oil life and against rust and corrosion to protect valuable machines. And, last but not least, because the leak-reducing agent is 100% petroleum, Suntac leaves no gummy film or residue.

For more information about Suntac, the oil especially made to prevent drip, throw-off and squeeze-out, see your Sun representative or write for your copy of Suntac Technical Bulletin to Sun Oil Company, Philadelphia 3, Pa. Dept. IA-6.

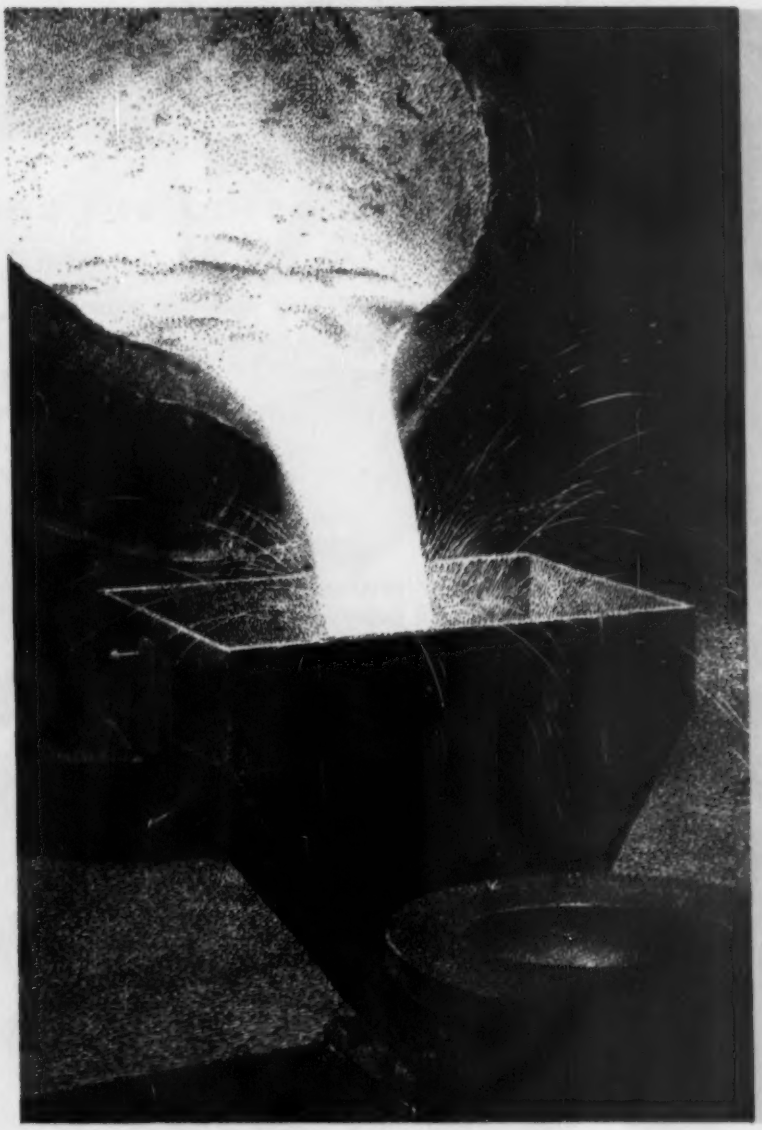
SUNOCO®

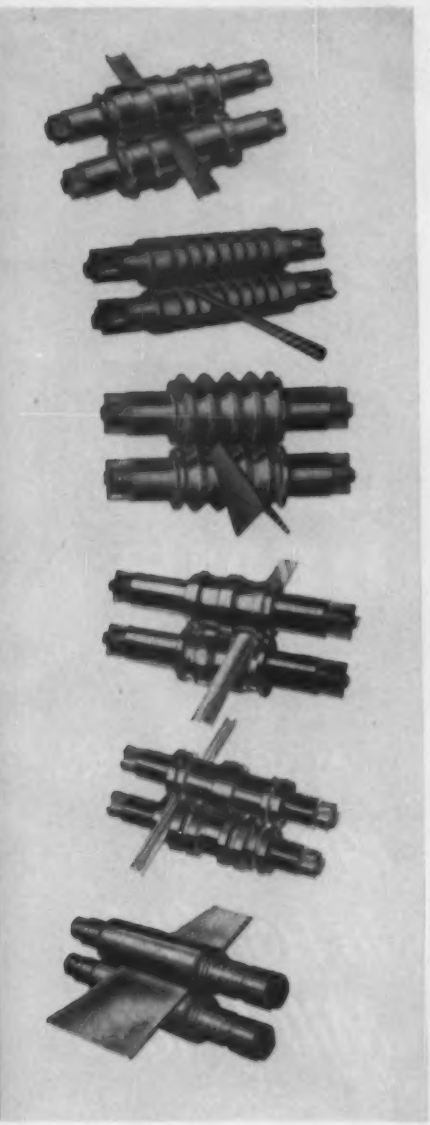
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POURING Top Quality ROLLS FOR MORE THAN 45 YEARS...

... Rolls that are sound, long-wearing ... rolls cast to the right hardness, chill depth, heat resistance ... iron, alloy iron and steel rolls that you can depend upon to give long tonnage life.

So, for rolls that meet your specifications for soundness and precision be sure to specify National Rolls. You'll be glad you did.

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The challenge of productivity, product quality and operating economy in hot strip mills grows tougher and tougher year after year.

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Mack-Hemp hot strip mill rolls are making outstanding records in many of today's high speed mills . . . the result of their long experience in roll-making backed by continual research plus close cooperation with mill operating staffs.

So, keep your eye on what's new and different at Mack-Hemp . . . it's your sure way of being able to maintain production figures high and cost figures low.

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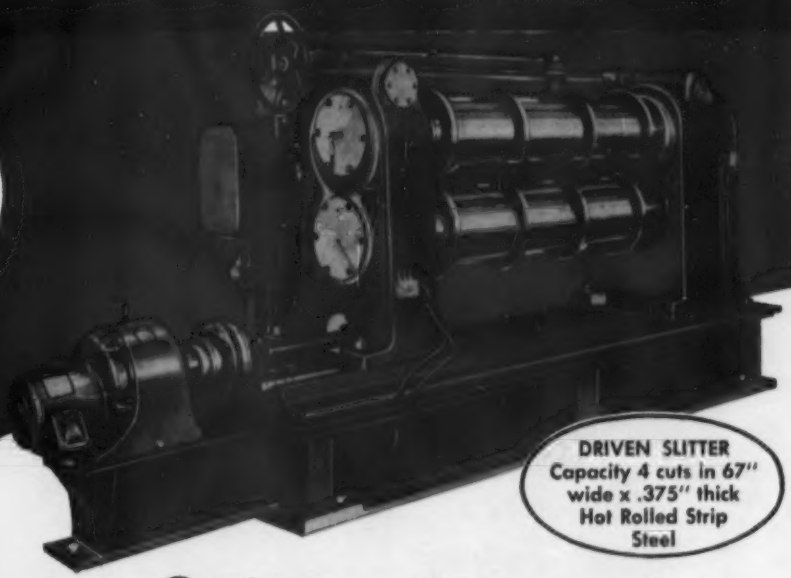
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DRIVEN SLITTER
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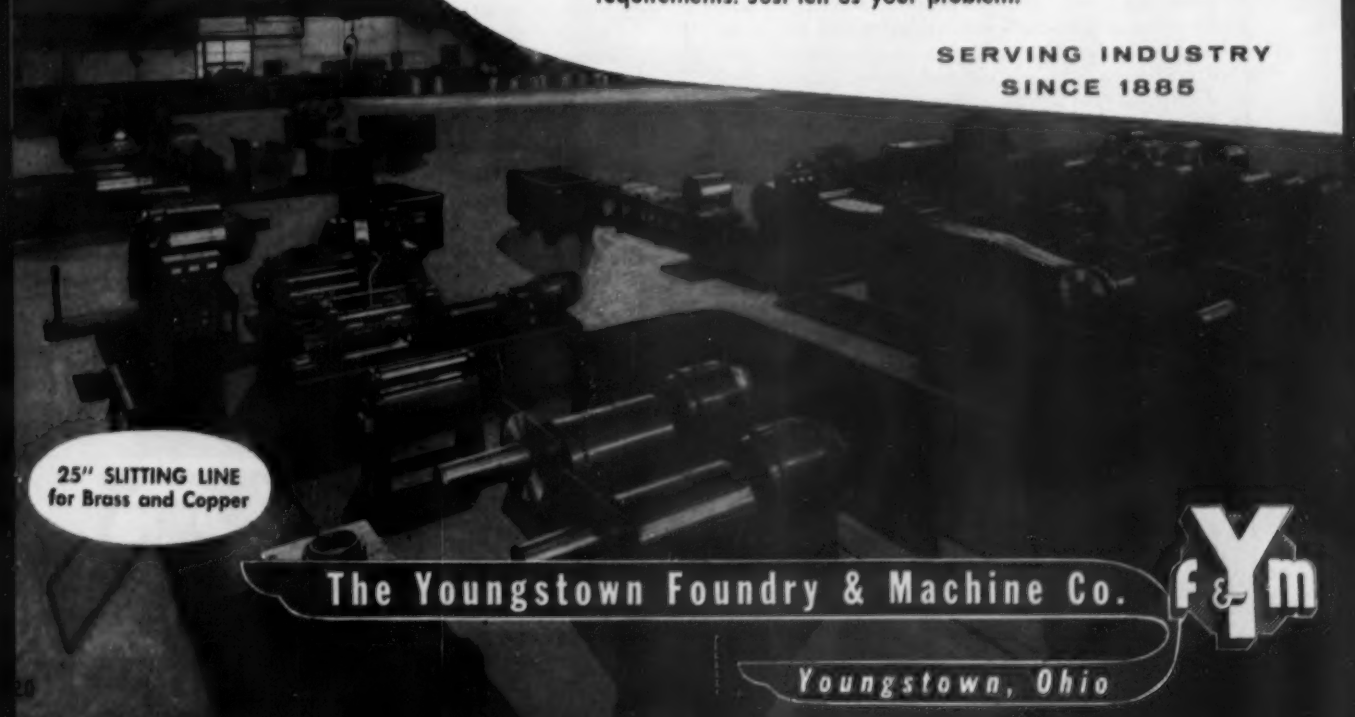
- SLITTERS AND SLITTING LINES
- PAY OFF REELS
- TAKE UP REELS
- UP CUT SHEARS
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and other Strip Mill Machinery

Precision Built Lines Engineered to Your Needs and Specifications

Savings are substantial when you "slit your own" and more so with equipment built exactly right for the job. Whether you slit non-ferrous or ferrous metals — light or heavy—thin or thick strip—it will pay you to investigate "Youngstown" slitting lines before you buy. Seventy years of experience is back of the designing, engineering and building of "YF&M" slitters and auxiliary equipment. Many installations for leading producers, fabricators and warehouses, offer proof of dependable, economical, profitable operation . . . evidence of our ability to supply the 100% correct answer to satisfy your individual requirements. Just tell us your problem!

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The Youngstown Foundry & Machine Co. Y F&M

Youngstown, Ohio



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Ever since the day in 1886 when Mr. Ivins succeeded in cold drawing the first seamless steel tube in America at the request of a brick machinery builder, the Ellwood Ivins Steel Tube Works has maintained a flexible operation in accordance with the requirements of the times and its clients.

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In 1946, after decades of helping to make notable contributions to the history of tube making, the ownership of the mill was assumed by a group of young but experienced tube manufacturers. The plant has been rehabilitated and equipped with the most modern machinery, and its policies revitalized. Today Ellwood Ivins represents the most versatile and diversified tube mill in the eastern part of the United States. Its ability to produce a wide range of sizes and important products as well as the unusual in tubing and fabricated parts has proven a great asset to many of our country's leading manufacturers.

The future, with its larger demands and ever changing needs, will find Ellwood Ivins eager and willing to serve American industry with greater resources and ingenuity.

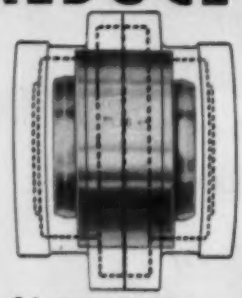
This organization takes this opportunity to congratulate the Iron Age for their distinguished contribution to the advancement of the metal-working arts and industries.

ELLWOOD IVINS

STEEL TUBE WORKS Inc.

Philadelphia 26, Pa., Phone: MAjestic 5-0460

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3/5 USUAL SIZE
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of flange type with same shaft size, HP capacity

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Smaller, lighter for lower moment of inertia, less wear on equipment, lower power costs, more compact designs. Simpler (only 7 parts) . . . assembled, uncoupled in *seconds*. Stronger, safer . . . one-piece forged steel sleeve transmits the load . . . no nuts, bolts, flanges. Call your Sier-Bath Coupling Distributor or Representative . . . send for CATALOG. *Sier-Bath Gear & Pump Co., 9274 Hudson Blvd., N. Bergen, New Jersey.*

Founded 1905 Member A.G.M.A.

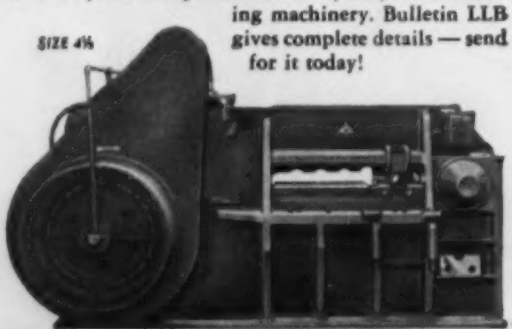


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This new BAR-BILLET shear has tremendous power and will cut rounds, flats, squares and special shapes without set-up changes. Clean, square cuts with a minimum of distortion, are guaranteed. Simplicity of design with fewer moving parts insures economical maintenance and the purchase price is LOW!

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The HILL ACME Co.

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Youngstown For Quality and Service

The Youngstown Sheet and Tube Company has established a reputation throughout the steel industry for quality and service that is jealously guarded by 27,000 employees who cooperate to produce and market a wide variety of steel products.

Pride in workmanship has been a hallmark of the Sheet and Tube employee since this company first started production at the turn of the century. Because we know reputations are won only in the field of performance, there is a continuous effort to further improve. . . .to further develop. . . .the qualities of our products.

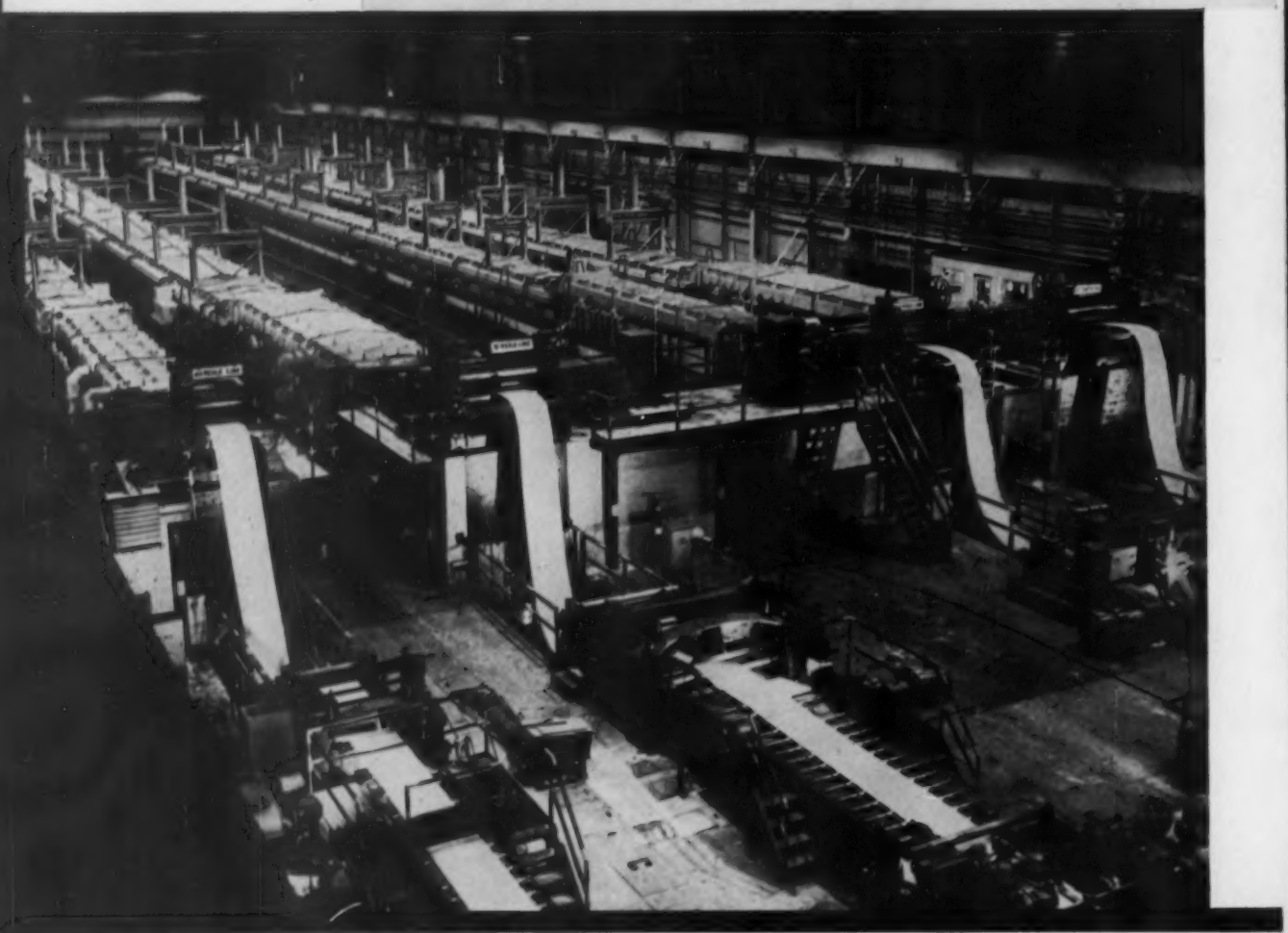
The apprentice at The Youngstown Sheet and Tube Company becomes immediately aware of the Company's high standards and is taught to guard and preserve them as he advances to more important and skilled work. Quality and service, which are featured in our trademark, are the standards by which all employees work.

THE YOUNGSTOWN SHEET AND TUBE COMPANY *Manufacturers of Carbon, Alloy and Yoloy Steel*

General Offices: Stambaugh Building - - Youngstown 1, Ohio
Plants: Youngstown, Ohio; Struthers, Ohio; Indiana Harbor, Indiana

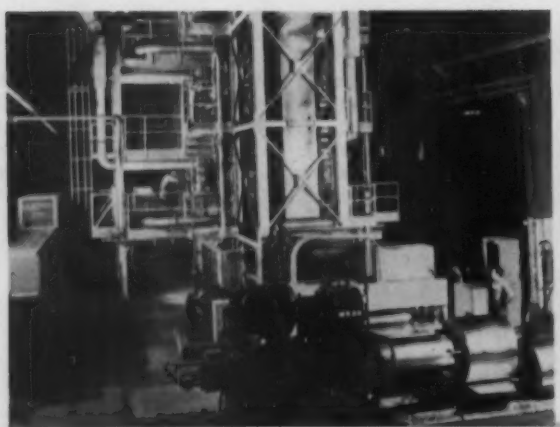
SHEETS - STRIP - PLATES - STANDARD PIPE - LINE PIPE - OIL COUNTRY TUBULAR GOODS - CONDUIT AND EMT - MECHANICAL TUBING - COLD FINISHED BARS - HOT ROLLED BARS - BAR SHAPES - WIRE - HOT ROLLED RODS - COKE TIN PLATE - ELECTROLYTIC TIN PLATE - RAILROAD TRACK SPIKES - MINE ROOF BOLTS

Wherever Steel

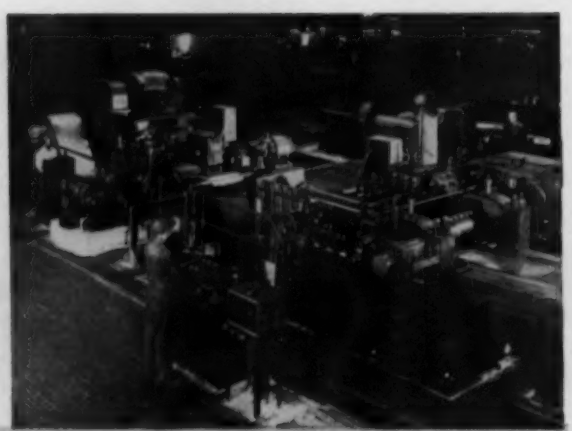


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ELECTROLYTIC TINNING LINE ▶



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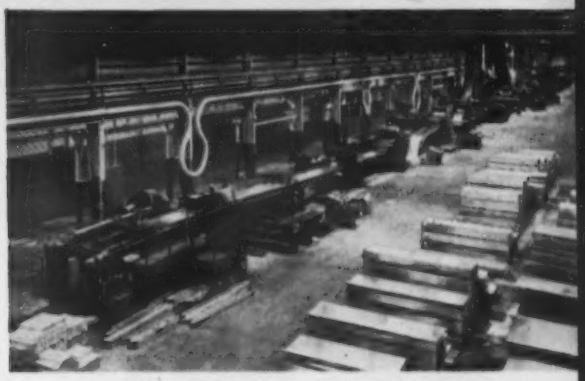


COLD STRIP SHEARING LINE

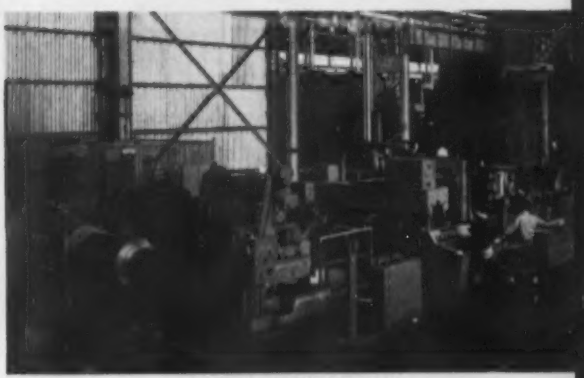
...is made...

You'll find modern Steel Processing Equipment conceived, designed and manufactured by

WEAN



CONTINUOUS STRIP GALVANIZING LINE



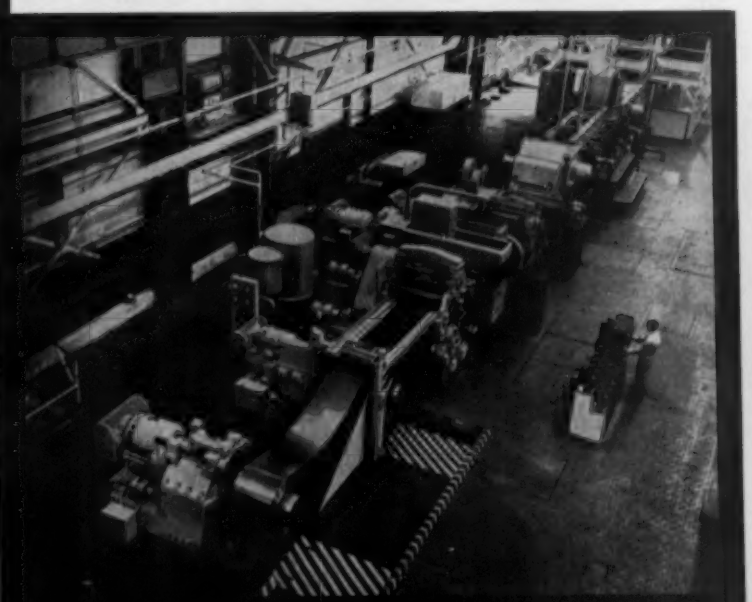
COIL PREPARATION LINE

● For over a quarter of a century that the Wean Engineering Company, Inc. has been a part of the American business scene there has actually been in progress a second industrial revolution.

Methods employed to produce and process steel in the late twenties and early thirties are no longer economical. The great demand for the various steel products, both for military and civilian purposes, has forced steel makers into demanding equipment that would produce steel faster and faster and, at the same time, develop new steels and improve old ones to make them more compatible with modern fabrication methods. To do this and in an economical fashion, steelmaking began a long process of redevelopment. Wide strip steel replaced sheets. Larger coils that would mean longer production runs became desirable. Continuous processing for annealing, coating, edging and coiling was developed and keeps the steel on the go in constantly increasing volume and at even greater speeds.

For more than 25 years, Wean engineers have played an important role in this revolution. It was these engineers who developed much of the continuous processing equipment and it was these engineers who championed high speed slitting and shearing systems. In fact, wherever you see a modern sheet, tin or strip mill facility in operation, chances are a good part of the working equipment carries the Wean Engineering nameplate.

The
WEAN ENGINEERING CO., INC.
WARREN, OHIO





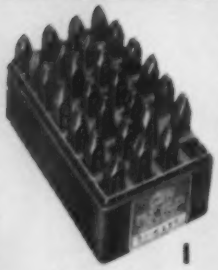
HOT STRIP SHEARING LINE

Mecco SAFETY — THE *Safe* MARKING TOOLS FOR INDUSTRY!

Mecco Safety steel—a tough heat-treated tool steel developed for marking service—provides freedom from spalling and mushrooming of marking tools, even in severest applications. A few Mecco Safety marking tools are shown—many more are available for every marking purpose.



Box Type Holder (Cat. 126)



Hevi-Bevl Stamps (Cat. 101)



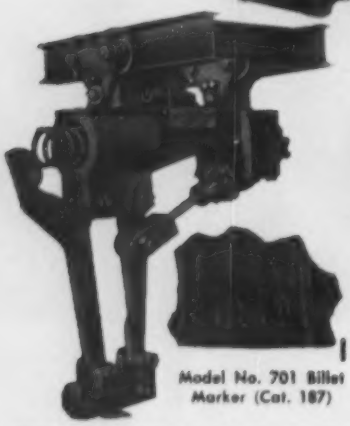
Axe Type Holder (Cat. 127)



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Model No. 701 Billet Marker (Cat. 187)



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Write for Catalog 100!

Mecco SAFETY MARKING TOOLS — M.E.CUNNINGHAM CO.

1026 CHATEAU STREET • PITTSBURGH 33, PA.

IRON and STEEL **PIPE** and **TUBING** 1/8" to 60"

All sizes stocked and fabricated. If your requirement is not made or is obsolete, we can manufacture any diameter & thickness promptly.

PIPE — steel wrought iron ⅛" to 60" all walls, couplings, valves and fittings.

TUBING — mechanical, structural, pressure and hydraulic.

Unusually heavy walls, odd and obsolete sizes our specialty.

Steel poles of all types manufactured for flag poles, lighting, street lights, booms, etc.

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PHILADELPHIA 34, PA.

Phones Uhderland 3-1113 Uhderland 3-5054

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OFFICE AND WAREHOUSE

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TELETYPE PH-238
PHONE: MArket 7-5850



Among Those Present

Of the 56 signers of the Declaration of Independence, four were ironmasters: George Taylor, of the Durham furnace, Bucks County, Pa.; Stephen Hopkins, of the Hope furnace, in Rhode Island; James Smith, who owned the works later known as Codorus forge, in York county, Pa.; and George Ross, a lawyer of Lancaster, Pa., who was interested in the Mary Ann furnace, the first blast furnace west of the Susquehanna.

Twenty-four men identified with the iron industry were prominent officers in Washington's Army.

Thus, from its beginnings, the United States has depended upon its men of iron for leadership—and upon a continuous flow of ferrous metals for the nation's preservation and expansion.

To maintain supplies of iron and steel to meet all needs, the flow of scrap must be uninterrupted.

For the purchase or sale of iron or steel scrap . . .

phone or write "Your Chicago Broker"

M. S. KAPLAN COMPANY

231 S. La Salle St., Chicago

Telephone ANdover 3-3900



Typical Koppers-Becker Coke Ovens. This battery of 65 ovens carbonizes approximately 1,400 net tons of coal per day at a coking rate of 1.08 inches per hour.

the PLUS FACTOR in Koppers Engineering Services



ANY company, engaged in metallurgical construction, must have engineering skill. It is the *common* denominator that goes into every one of our construction assignments.

Included in Koppers Metallurgical Engineering and Construction Services is a value that is of intangible, but very real benefit to the company's customers. This value is based on more than fundamental engineering skills. Rather, it stems from all of the varied knowledge, techniques and background that have been acquired over the years by Koppers Engineers in handling the most exacting metallurgical construction projects.

Difficult to define or measure, this unseen value is in fact the Plus Factor of Koppers Engineering Services that makes for customer satisfaction. You are invited to consult with our Engineers and Management.

For any kind of metallurgical construction
YOU CAN COUNT ON KOPPERS

KOPPERS®

Engineering and Construction Division

KOPPERS COMPANY, INC.
Pittsburgh 19, Pennsylvania

New Freyn-Design Blast Furnace. Soaring 225 feet skyward, this furnace has a hearth diameter of 25 feet and a capacity of 1,100 net tons of iron per day.

Capsule Case History:



From **A** to **Z**...



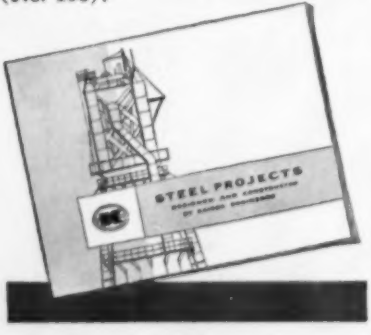
No matter how varied or complex the related facilities involved in the design and construction of your new plant, Kaiser Engineers has the breadth of experience and qualified personnel to assume sole responsibility for the design and construction of the complete project.



Building a Steel Mill
from the ground up is a complex project requiring the combined efforts of many crafts, trades and services, of diverse engineering skills and construction know-how.

Kaiser Engineers team of specialists designed and built the West Coast's only integrated steel mill from coal and iron ore mines, blast furnaces and rolling mills, to air pollution control of the open hearth stacks.

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STAINLESS STEEL FOR BUILDINGS



McLouth STAINLESS Steel

High quality stainless sheet and strip steel . . . for the product you make today and the product you plan for tomorrow.

McLouth Steel Corporation
DETROIT, MICHIGAN
Manufacturers of Stainless and Carbon Steels

BLISS & LAUGHLIN'S

NEW STANDARD OF QUALITY

LUSTERIZED*

COLD DRAWN FINISH



THE NEW LOOK...
a New Quality Concept
in Cold Drawn Bars

SEE IT
BUY IT
TRY IT

COLD FINISHED CARBON AND ALLOY STEEL BARS

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BLISS & LAUGHLIN, INC.

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SALES OFFICES
IN ALL PRINCIPAL CITIES

FOUR PLANTS:—



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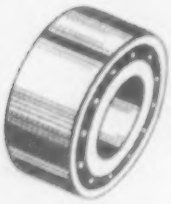


BUFFALO, N. Y.



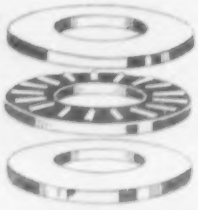
MANSFIELD, MASS.


Bright as tomorrow!–Right for the years!
SUPERIOR
stainless strip steel
The sparkle that catches the car buyer's eye is a *permanent* pleasure with Superior Stainless. Time can't dull the bright-work made of this solid-bright metal. Superior Stainless Strip Steel is the dress-up feature that helps make the sale —and through superior performance, helps keep each owner sold. • Let us give you the facts on fabricating ease, gauges, tempers, finishes and coil widths for your needs.
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CARNEGIE, PENNSYLVANIA



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First solid cylindrical roller bearings for steel mill motors



1925

First solid cylindrical roller thrust bearings for crane hooks

solid cylindrical roller bearings

for every type of steel mill operation . . .

FOR HEAVY DUTY



Radial Type, Bronze Retainer

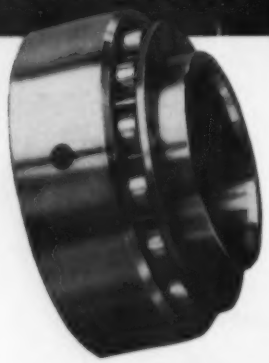


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There is probably no better way to highlight the importance of this discovery than to quote the American Iron and Steel Institute when it described the process of making seamless tubing as "THE GREAT PIPE TRICK," calling it "one of the neatest achievements of the Steel Industry," when "putting a hole down the middle of a tough steel round and leaving no visible trace of how it got there."

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100 YEARS
machine tools
OF METALWORKING

MACHINE TOOLS 1855 1955

AN IMPRESSIVE variety of machine tools was available to the metal industries by 1855. The list included turret lathes, planers, shapers, milling machines, profilers, drilling machines and gear cutting equipment. By modern standards all of these tools were crude and many of them frillishly ornate. But any of them would be instantly recognizable as prototypes of present day models.

All of these machines were important to the vigorous era of product and process development that was well underway in 1855. But two of them in particular, first built in that same year and the year following, played an outstanding part in the growth of the machine tool industry and the art of precision metalworking. One was the famous "Lincoln" plain milling machine; the other was the turret lathe.

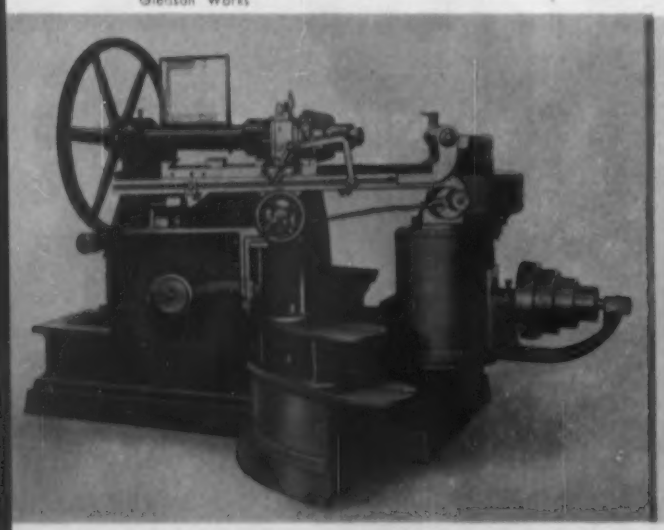
The "Lincoln" miller was designed by Francis A. Pratt in 1855 while he was superintendent of the George S. Lincoln Co. in Hartford, Conn. It closely resembled a machine which had been designed by Frederick Howe a few years earlier and built by the Robbins & Lawrence Co. in Windsor, Vt. But the improved Pratt design substituted a screw feed for the table instead of the rack and pinion used by Howe.

Pratt's machine was actually built by Amos Whitney, who was then the "contract" builder for the Lincoln Co. The first production model was sold to the Colt Armory in Hartford. It is said that at least 200,000 of these machines were later sold in the U. S. and abroad.

Lathes equipped with horizontal or vertical type turret tool holders were actually in machine shop use before 1850. But these features were for special purpose work and lathes so equipped were not built for sale.

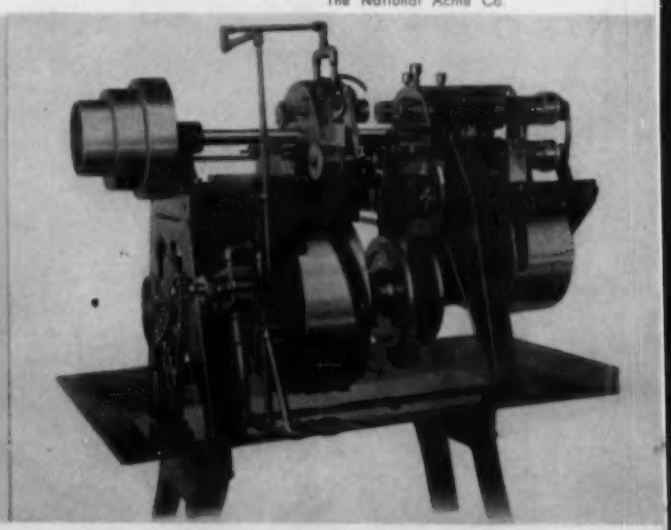
The first turret lathes built to be sold com-

Gleason Works



WILLIAM Gleason invented this bevel gear planer in 1874 to replace crude hand chipping.

The National Acme Co.



HENN and Hakewessel built the first successful 4-spindle automatic screw machine in 1893.

mercially were made in 1856 by the Robbins & Lawrence Co. from the design of Henry D. Stone. Stone's turret revolved about a horizontal axis.

Machine tools in this era were lubricated with various animal and vegetable oils which were not too efficient. Such oils had the distressing habit of becoming rancid through heat and oxidation. And so-called "rock oil" at that time was thought to be useful only for producing kerosene for illuminating purposes.

But then, in 1859, E. L. Drake drilled the first U. S. oil well at Titusville, Pa. The many petroleum developments which followed this discovery soon contributed greatly to improved machine tool lubrication, and later made possible smooth hydraulic control of feed and speed mechanisms.

Two years later, in 1861, Brown & Sharpe sold its first machine tool to the neighboring Providence Tool Co. It was a turret screw making machine, closely modeled after an earlier type designed by Frederick W. Howe and built by the Robbins & Lawrence Co. In fact, Howe, who was Providence Tool Co.'s superintendent in 1861, obtained the original Robbins & Lawrence patterns, and the principal parts of the Brown & Sharpe machine were cast from these. J. R. Brown added several improvements to the original machine. Most important of these was an automatic feeder.

Invent self-revolving turret

Francis Pratt and Amos Whitney, who had formed their own firm in 1860, also marketed a turret screw machine in 1861. Their version had a self-revolving turret head, another major improvement over earlier hand operated models.

In 1862, Brown & Sharpe produced both the first truly universal milling machine and the modern formed milling cutter. Plain milling machines such as Pratt's "Lincoln" type and Howe's so-called "Universal" model of 1852, had then been in use for many years. But Brown's design was considerably different from these.

Actually, the appearance of this universal milling machine is typical of the industry's evolutionary growth pattern; primarily a process of adapting existing models to new needs through some design innovation.

The universal miller developed from a problem involving twist drills. A great many drilling operations were required in gun manufacturing for the Civil War then in progress, but drill flutes were still tediously made by hand filing. This bothered Frederick Howe, who consulted J. R. Brown about the possibility of finding a better and quicker way to do the job.

Brown agreed that he had a similar problem in cutting spiral grooves in his own plant. From his experience in the use of gears and his knowledge of milling machines (including Howe's own 1852 design), Brown conceived his universal model. And he designed it not only to groove twist drills, but to serve many other machine shop purposes.

A drawing of the new milling machine, dated October, 1861, and bearing Brown's signature, shows all the vital elements of the modern knee and column type. The Patent Office record also shows three basic claims. It was a tribute to their soundness that apparently no attempts were made to infringe or evade them while the patents remained in force.

Patent showed foresight

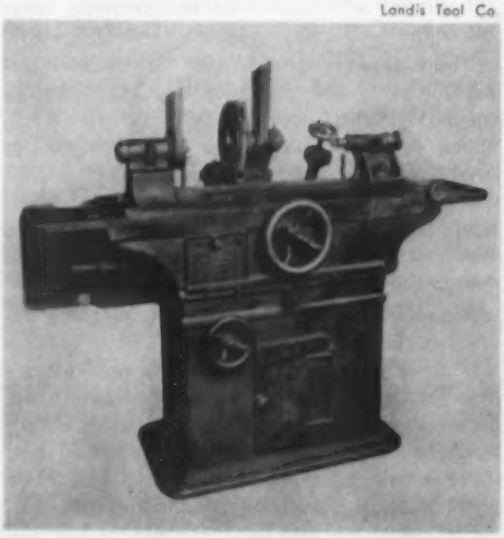
The first claim referred to a knee-type machine having a revolving cutter spindle, a cross-slide, and a swiveling plate carrying a sliding table. The second pertained to a connection between the sliding table and a spindle for cutting spirals. The third claim described a swinging block as part of the spiral head, which allowed indexing work held at an angle. All the patent specifications were clearly detailed as to the machine's potential uses.

The first of these universal millers was installed at The Providence Tool Co., March 14, 1862. Frederick Howe insistently refused any credit for Brown's acomplishment, although his early design for Robbins & Lawrence and his discussions with Brown undoubtedly influenced the latter's thinking.

Brown quickly followed his machine design with the first formed milling cutter. This tool, which could be resharpened without changing its cutting form, widened the entire field of use for milling machines and stimulated sales of the Brown & Sharpe universal.

Meanwhile in the early 1860's, two Phila-

Landis Tool Co.



THE original Landis grinder, built in 1885, traversed the wheelhead instead of workhead.

delphians, William Sellers and William B. Bement, were helping their city to become the country's largest machine tool production center. Philadelphia held this position after the Civil War, some years before Cincinnati assumed the honor.

Sellers invented the spiral gear planer in 1862. He was also one of the first U. S. builders to discard ornate machine tool design in favor of more functional treatment. He scrapped the prevalent custom of using red paint, beaded molding and other architectural flourishes, and was the first to paint his more serviceable looking equipment with the now famous "machine tool gray."

It was Sellers and Bement also, who started the trend toward heavier machine tools. Their equipment attained an outstanding reputation for massiveness and rigidity.

Until 1864, the art of grinding metal had been very crude, to say the least. In that year J. R. Brown started investigating grinding techniques, but he found little to work with. Emery abrasive wheels were available only in elementary hand made forms and were far from satisfactory.

Nevertheless it was clear that the fastgrowing sewing machine industry needed a production cylindrical grinding machine, and in 1864 Brown developed one. It was actually a 14-in. Putnam lathe modified to mount a small emery wheel on the carriage. The inventor also added an automatic feeding and reversing attachment and a dead center pulley.

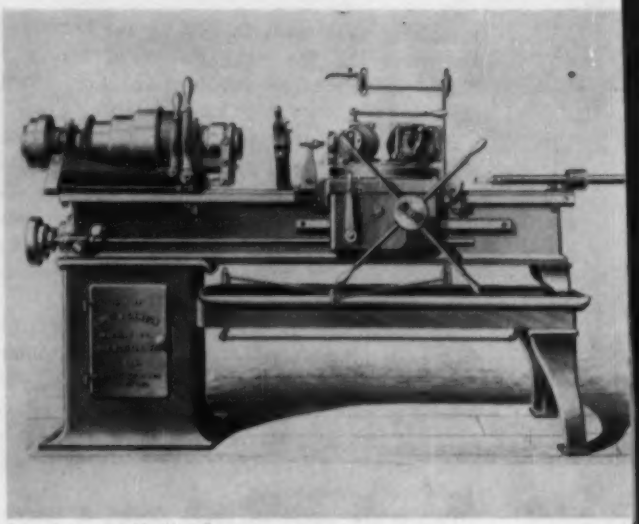
Grinding widely applied

Despite the lack of suitable abrasive wheels, cylindrical grinding came to be rather widely applied in the late 1860's and early 70's. In 1867, J. Morton Poole designed and built a useful double wheel machine for grinding large rolls.

There were apparently few major machine tool developments between 1868 and 1873. But in the latter year, three events of future significance occurred: The term "broaching" was used for the first time in a patent application; Swen Pulson began "burning" emery wheel bonds at the Norton & Hancock Pottery in Worcester, Mass.; and Christopher Spencer invented the automatic turret lathe.

Broaching as a production metalworking operation didn't really exist in 1873; the process was many years in the future. As for Pulson's first attempts to vitrify an emery wheel bond, his employer, Frank Norton, didn't even bother to apply for a patent on Pulson's process until three years later. But Spencer's automatic screw making lathe was an immediate success.

Christoper Spencer was another of the mechanical geniuses of his day. He was already renowned for a successful automatic machine



Jones & Lamson Machine Co.

HARTNESS "flat-turret" lathe, patented in 1891, was popular in a 2 x 24-in. bar model.

that turned sewing machine bobbins out of bar stock, and this led him to invent a somewhat similar unit to produce machine screws rapidly and accurately. His development work was done in a rented loft of the old Cushman Chuck Co. plant in Hartford.

Although Spencer's machine was a basic invention, his patent attorney failed to grasp the significance of its most important feature. This was the blank cam cylinder on which flat strips of metal could be adjusted to accommodate various jobs of work.

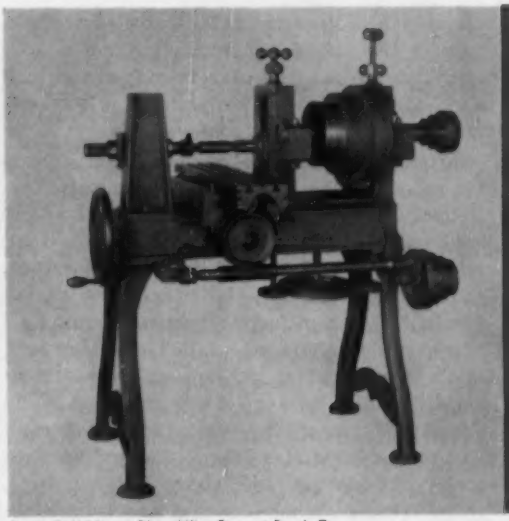
Since patent rights were not obtained on this camming method, other firms quickly adapted it to screw making machines of their own design. Spencer missed out on the full financial rewards of his invention, but his legitimate moral claim to the idea was never disputed.

Three other important "firsts" in machine tool history next occurred in 1874: William Gleason invented the bevel gear planer; the first centerless grinding patent was issued; and Cincinnati's rise to world prominence in machine tool building started when Henry Bickford rented a small room in that city to begin making upright drilling machines.

Gear planer instant success

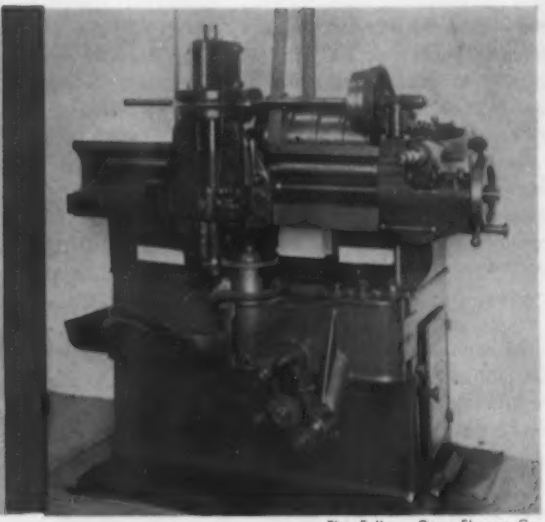
Centerless grinding was not destined to be widely applied for many years, but the new bevel gear planer from Gleason's small Rochester, N. Y., shop filled a pressing need.

Previously, bevel gears had been crudely made by hand chipping and filing; they were noisy and limited in load carrying capacity. The new planer eliminated these problems, making it possible to produce accurate gears in large quantities.



Pratt & Whitney Div., Niles-Bement-Pond Co.

FAMOUS "Lincoln" milling machine was first built in 1855. Over 200,000 were sold.



The Fellows Gear Shaper Co.

THE original Fellows gear shaper. Introduced in 1897, it featured a relieved-edge cutter.

Truly convincing evidence of all this post-Civil War machine tool progress was demonstrated at Philadelphia's Centennial International Exhibition in 1876. Outstanding displays were assembled there by Brown & Sharpe, William Sellers & Co., Pratt & Whitney, the Putnam Machine Co. and others.

Brown & Sharpe's new universal grinding machine received marked attention at the Philadelphia show. It was the outcome of Brown's realization that his modified Putnam lathe of 1864 was not essentially the grinder that industry needed. He designed his new universal model sometime prior to 1874, the year in which it was actually built. It was this first machine which was shown at Philadelphia. Brown died in 1876, but his heirs received a patent on the universal grinder in 1877.

By 1877 there were an estimated 12 U. S. firms principally engaged in machine tool manufacturing. They employed about 2000 workers, and the industry's total capital investment was judged to be about $2 million. This small builder group led the world in equipment quality and quantity.

In 1877, gear cutting techniques advanced again when Brown & Sharpe introduced two new automatic machines. One was a small manufacturing model for bevel and spur gears; the other was a larger unit for general purpose use. Both were designed by Edward H. Parks, who had continued J. R. Brown's studies of involute and epicycloidal gear cutting after the latter's death.

In 1880, Frederick W. Taylor began his 26-year studies on production techniques. His research on metal cutting led to the widespread use of high speed steel cutting tools, which had a profound effect on future machine tool design. The new steels soon made it possible to take much heavier machining cuts at speeds up to 2½ times faster than carbon steel tools could stand.

Taylor's principal backer was machine tool builder William Sellers, who was also president of Philadelphia's Midvale Steel Co., where Taylor started his monumental work. Despite constant opposition, Sellers never wavered in his enthusiastic support of Taylor and his associates.

Radial drills introduced

In 1880, also, the first plain and universal round column radial drills were built in Cincinnati by the Universal Radial Drill Co. George A. Gray, who designed these machine tools, later organized the present G. A. Gray Co., which specializes in planer manufacturing.

Prior to 1882, internal squares, keyways and splines were made by hammering punches or drifts through round holes. Occasionally an arbor press was used to drive the forming tool through the work. Although the internal broaching machine was still to come, a machine tool was patented in 1882 for broaching external surfaces. This power-driven unit used a rack and pinion drive, but the process was uneven and tended to set up considerable chatter.

Chronologically, the next major machine tool development occurred in the boring machine. Progress in these tools from the time of Wilkinson's British-built original had been chiefly toward bigger equipment. But then the first small boring machine to do accurate, lathe-type

work was designed by E. P. Bullard and built at the Bridgeport Machine Tool Works in 1883. It was a single head, belt feed machine of 37-in. capacity, and was the forerunner of the modern vertical turret lathe.

In 1885, A. B. Landis designed the first grinding machine which traversed the wheelhead instead of the workhead. Landis received a patent in 1890, and the present Landis Tool Co. in Waynesboro, Pa., was organized.

Cincinnati builders prominent

In the latter years of the 1880-1890 decade, Cincinnati machine tool builders acquired a reputation for producing a variety of excellent equipment to original designs. They were no longer copying Eastern-built machinery; instead they were making a strong bid for leadership in the industry.

Over the next 10-year span a series of developments in metal grinding contributed greatly to machine tool progress. They began in 1890, when Frederick M. Gardner invented the disc grinder. And the scope of this and all other grinding methods was soon enhanced by two more far-reaching circumstances; Dr. Edward Acheson's discovery of the silicon carbide manufacturing process in 1891, and Charles B. Jacobs' successful production of aluminum oxide in 1896.

In the area of conventional metal cutting equipment, the Jones & Lamson Machine Co. introduced the "Hartness" flat-turret lathe in 1891. It eliminated the so-called "cob house" turret lathe design in which tool slides were piled atop one another and cutting tools hung far over their supports. James Hartness developed a basic single slide machine which the company standardized in a 2 x 24-in. bar model.

It was also inevitable that someone would conceive the idea for a multiple spindle automatic turret lathe or screw machine which would allow all of the turret tools to work simultaneously.

Christopher Spencer caught the germ of this idea soon after he built his first automatic turret lathe in 1873. Around 1890 he brought sketches of a new machine to Edward C. Henn and Reinhold Hakewessell in their Hartford, Conn. shop. Henn and Hakewessel contracted to built 25 of them for the Spencer Screw Co.

Spencer's machine was called the "Jumping Jack." A vertical stock support slide accommodated coiled wire up to ⅜-in. diam. The slide moved upward by action of a step cam, and stopped at successive points in line with revolving tools set one above another in a vertical frame. When a screw was completely machined the vertical stock support dropped back down to its initial position.

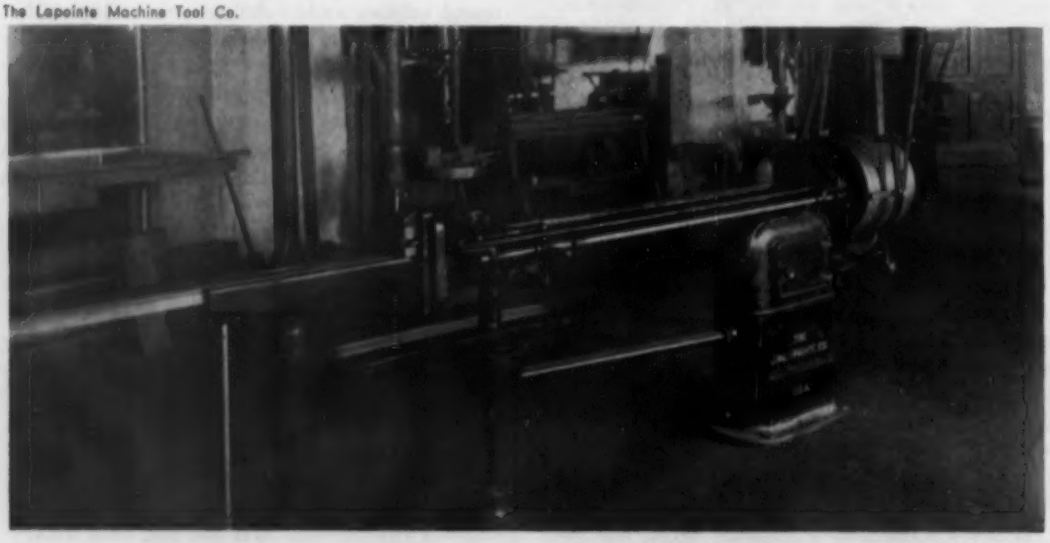
Develop metal cutting bandsaw

Work on the "Jumping Jack" gave Henn and Hakewessell the idea for revolving four work spindles in a headstock which would also index one quadrant at a time. They matched the four work spindles with an equal number of tool positions on a sliding horizontal turret. The turret advanced once for each quarter revolution of the spindle carrier, and produced a finished piece of work at the final tooling position each time it did so.

The partners produced their first machine in 1893, naming it the "Acme." It was the predecessor of the line of multiple spindle machines now built by the National Acme Co.

In 1893 Henry Disston & Sons, Inc., announced that they had developed a metal cutting

The Lapointe Machine Tool Co.



THIS Model 3 Lapointe screw-type broaching machine of 1902 was a major development.

bandsaw which expanded the useful area of what had been primarily a woodworking tool.

The famous Fellows gear shaper and its companion cutter with relieved edges were first introduced in 1897. The shaper operated on the molding-generating principle with the cutter reciprocating as it revolved in harmony with the gear being cut.

In 1898, the Potter & Johnson Co. of Pawtucket, R. I., built and patented an original automatic chucking and turning machine and a lever chuck which permitted chucking the work without stopping the spindle.

The arrival of the 20th century and the fast growth of the automotive industry sparked a new era for machine tool progress. To start the parade, The Cincinnati Milling Machine Co. received top honors at the 1900 Paris World's Fair for its first milling machine to feature an all geared, positive feed mechanism.

In 1902, J. N. Lapointe formed a company to build the first screw-type broaching machines and their companion broaching tools. In that same year there were an estimated 150 U. S. machine tool builders employing some 25,000 workers. Cincinnati had become the recognized world center for this basic activity.

Gridley designs automatics

The Windsor Mfg. Co. of Windsor, Vt., built a basically new single spindle automatic turret lathe in 1904 which was designed by George Gridley. The turret was integral with a massive pin passing through the headstock, and held the new type high speed steel tools rigidly upon solidly supported individual slides. In 1907 Gridley designed his four-spindle automatic, with its twin-disk spindle carrier as an integral part of a heavy central shaft.

William Bryant applied for a patent on a multiple spindle chucking grinder in 1907, also. Two years later the present Bryant Chucking Grinder Co. was organized.

To accommodate the belt-driven drilling equipment of this era to the speed and power potential of high speed steel drills, B. Frank Barnes conceived the idea of using all geared speeds and feeds. His Barnes Drill Co., Rockford, Ill., produced the first drill of this type in 1907, and its basic features are still retained in the firm's modern drilling machines.

In 1913, answering the automotive industry's demand for more and better bevel gears, The Gleason Works developed a process, a machine and a tool for cutting spiral bevel gears in production quantities.

Immediately prior to World War I most machine tools featured fully geared speed and feed change mechanisms, and a few even had self-contained motors. In the same era, steady improvements in lubricating oils, straight and soluble-type cutting fluids, anti-friction bearings and high speed steels contributed greatly to overall machine tool excellence. During the war itself, demand for volume arms production stimulated many innovations in machines and tooling.

Among the post-war developments, precision honing was developed in France and introduced to the U. S. about 1920. In 1924 the Barnes Drill Co. built one of the first honing machines in this country. Soon after, multiple spindle honing equipment gradually superseded internal grinders for final finishing work on automotive cylinder block bores.

Hydraulic controls appear

Hydraulic controls appeared on many machine tools in the mid 1920's as builders used better hydraulic oils and precision fittings in a variety of smooth, stepless regulating devices.

About 1928, cemented tungsten carbide cutting tools were brought to the United States from Germany. This started a new era of machine tool development, fully as significant as that which Taylor's work on high speed steels had prompted some 50 years previously.

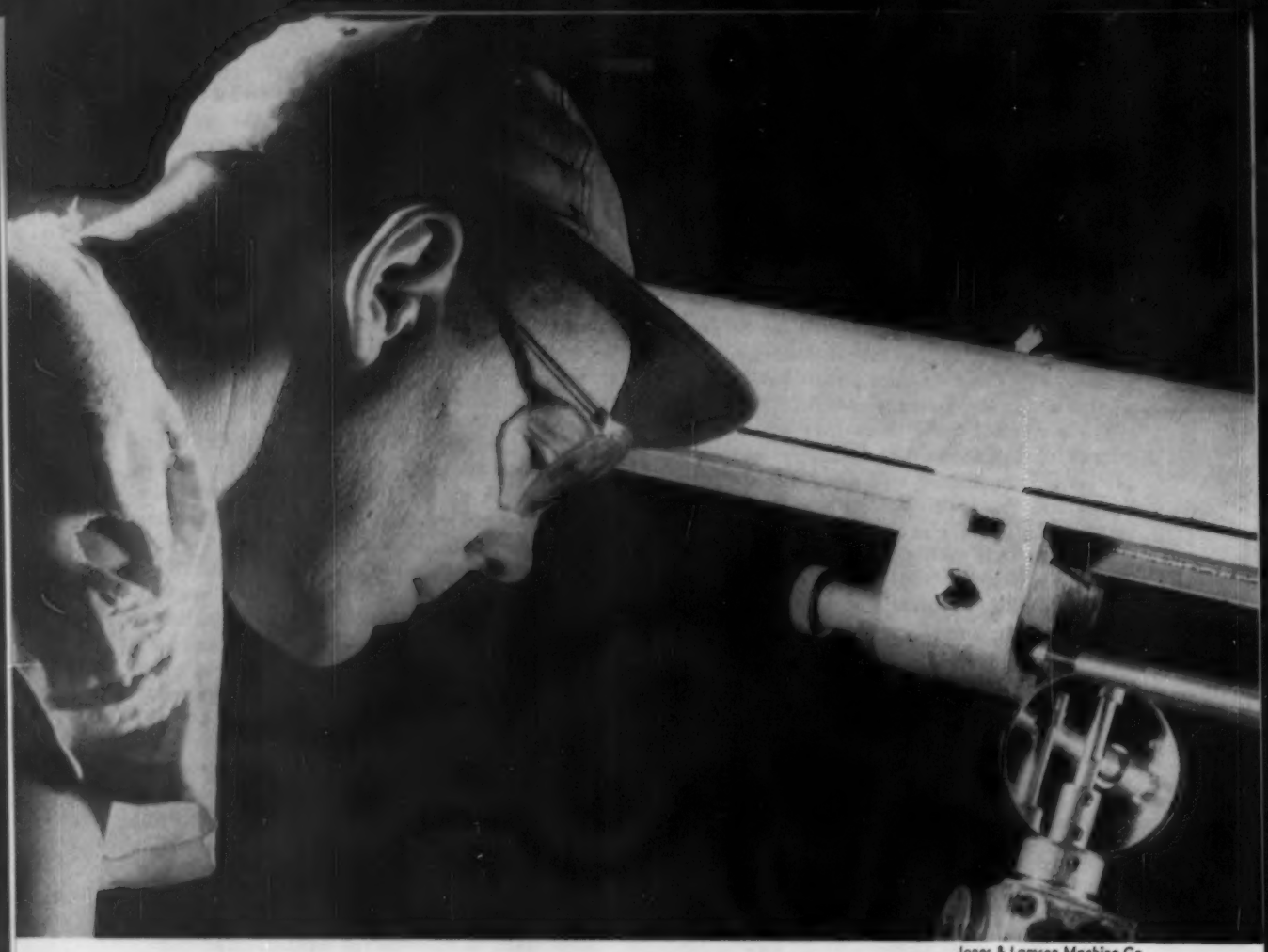
Builders immediately put more speed, power and accuracy into their equipment to match the metal removal rates now possible with the new cemented carbides as well as the cast alloys and improved high speed steels. Cutting fluids, coolant mixtures and their methods of application were also improved to dissipate the heat generated in both tools and workpieces at these radically new feeds and speeds.

From 1929 to the present day, machine tool evolution has continued along the traditional parallel paths of speed and accuracy. Although the rate of progress has speeded up tremendously, many of today's basic machine tools bear striking resemblances to 1855 prototypes.

Brown & Sharpe Mfg. Co.



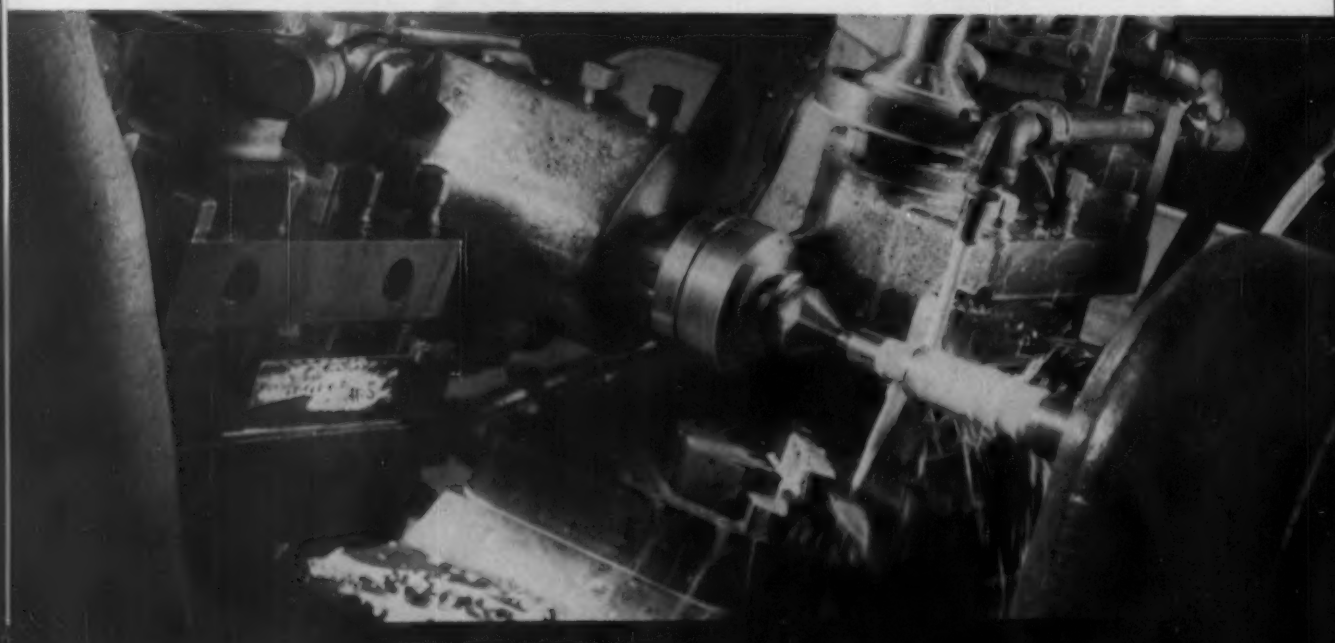
FIRST truly universal milling machine was this Brown & Sharpe model introduced in 1862.



Jones & Lamson Machine Co.

HYDRAULIC
tracing attachment
used in turning a shaft.
Template is at upper right.

MACHINE TOOLS...



the present

THE need for greater productivity, lower unit cost and increased flexibility has dominated the demands of the machine tool user during the entire postwar period. This requirement for greater productivity has been met by greatly increasing feeds and speeds while simultaneously handling parts in and out of machines automatically.

While the term, "automation" has been widely used to describe this phenomenon, it should be recognized that automatic handling is actually only a single phase of the very broad tooling program that has been evolved to improve production efficiency in the modern metalworking plant.

Originally, automation meant simply automatic handling of parts between progressive production processes. Today, automation begins with the elimination of unnecessary work handling operations. As tooling experts have pointed out, placing two tools on a lathe to cut two diameters simultaneously is just as much an example of automation as moving a piece automatically from one machine to the next. The use of multiple drilling and milling has, of course, been going on for a long time.

There are today many examples of automation in which a single station machine uses multiple or combination tooling. These include multiple-slide lathes, multiple-spindle drill presses, two-way, three-way and four-way boring machines, and multiple-spindle milling machines. Combination tooling has been developed to an amazing degree using only single station machines.

The second step toward automation is the use of dial or trunnion-type multiple-station machines if for no other reason than to relieve the congestion on single station machines. It has been observed that some modern single station machines seem to have heads coming out in every direction.

The demand of many applications for more stations than the dial or trunnion-type machine can provide—led to the development of in-line transfer machines. Automatic positioning, cleaning, inspection and assembly may be built into the latest type transfer machine lines.

The need to change tools imposes a practical limit on the size of in-line transfer machines. Obviously, downtime to change tools increases with the number of working tools. This has led to a very important development—automatic tool programming in which tool changes are prescheduled, using a mechanical memory device.

During a period characterized by outstanding advances in the design and efficiency of special machine tools, the so-called standard machines have kept pace. In recent years, standard machine tools have made significant gains, both as to design and performance. Recently-built machines have greatly improved rigidity and accuracy. They have many more automatic features than their predecessors. They remove metal faster and are much easier to operate. In

terms of versatility, accuracy and productivity, the gains achieved in standard machine tools have been significant.

Through the use of special attachments, including contouring devices, pre-selector heads and automatic feeds, standard machine tools can now be readily converted to semi-production tools having many automatic features.

Twenty-five years ago turning speeds seldom exceeded 100 fpm. Today, turning speeds as high as 1500 fpm on steel are possible. Even higher speeds are available, of course, where special machines are used to cut aluminum and light metal alloys.

The power of lathes being built today is generally double that of machines built as recently as 10 years ago.

Multi-tooled lathes of both the turret and the slide type are becoming increasingly popular. More recently, tracer-controlled or contour lathes have undergone spectacular development, including the use of tape or punch card controls.

On modern lathes, rapid traverse, feed, dwell and rapid return are automatic and can be re-set. Thus, an up-to-date turning machine has become an effective device for removing large amounts of metal with great accuracy; in addition, the versatility of modern lathes greatly surpasses the capacity of earlier models.

Built-in micrometers are now available to adjust for wear. Some types of lathe can be used equally well either as a manually-controlled engine lathe or as a semi-automatic production machine.

The insistent demand for lowering costs by getting more tools on more work, simultaneously and successively, in less time and floor space and with less manual effort, has provided the multiple-spindle bar automatic with a challenge that had to be met with ingenuity and sound engineering.

Originally, screws, nuts, pins and collars were about the only items produced in sufficient volume to make an automatic machine profitable. Today, the work for an automatic is of wide variety, ranging from cutting operations to spinning and even induction hardening. Diameters range from ¼ to 7¼ in.; lengths range from 1/16 to 31 in. Surveys estimate the total of the automatics having 4, 5, 6 and 8 spindles actually exceeds the total work spindles of single bar automatics and turret lathes combined.

Tooling arrangement and operational sequence may often determine the advantage to the user of one machine over another, regardless of the nature of the job or the length of run. On the other hand, a facility for fast change of tools and attachments is very useful for grouped runs, although this is not necessary for machines confined to the continuous production of one part.

The trend toward automation of grinding operations has been very rapid during the past few years. Remarkably dexterous facilities for loading and unloading are now available. Improved automatic wheel dressing and size control equipment is on the market. The increased use of crush grinding has made possible the production of a number of critical parts to tolerances that were previously impractical.

With more rigid grinding machines and better wheels has come better surface finishes—where they are needed. Both external and internal surfaces can now be held within extremely close limits. The recent development of better surface finish gages has fortunately accompanied the development of better grinding methods.

Crush forming of a grinding wheel by running it against a steel roller having the desired contour represents an important forward step in the development of grinding technology.

Diamond-dressed contoured grinding wheels are playing an increasingly important role in the big volume production plants, both for the production of parts and for tool sharpening. Many



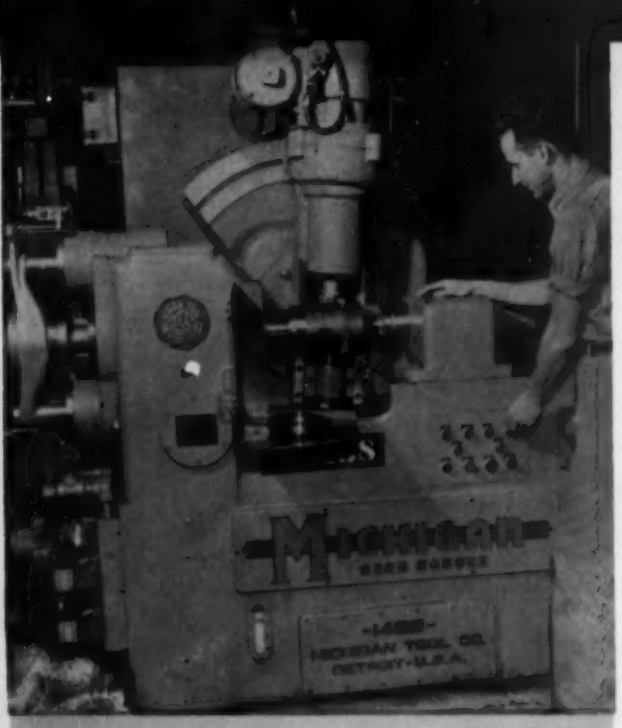
1 Brown & Sharpe Mfg. Co.

gears are now being finish ground with special grinding wheels.

Both the efficiency and cleanliness of grinding operations have been improved by the introduction of magnetic separators and cloth or paper filters. Where very close tolerances have to be met, refrigeration equipment is employed to hold the coolant at constant temperature.

A significant advance in grinding in recent years is the expanding use of belt grinding, a technique now being used on items ranging from steel sheets to gas turbine blades. Some installations, including setups for highly intricate parts, are fully automatic; some are semi-automatic.

Honing applications have been greatly extended in recent years. New mechanically-reciprocated machines and diagonal stone tools have



2 Michigan Tool Co.

made the honing of bores as small as 0.078 in. in diam possible and practical.

Several major transmission manufacturers are now finishing the splines in gears (after hardening) by honing. Using a special honing process, it is possible to generate a true radius on all load-carrying surfaces and obtain a finish that will not pick up on the shaft.

Honing is employed to taper both short bearing surfaces and long surfaces such as the outer barrels of large guns. A tool has been developed that will enable the gun maker to generate a uniform taper of any length and check the accuracy of the taper without removing the barrel from the machine.

The principles of honing are also used to generate flat surfaces on many production parts. Bonded abrasive wheels are used and high production is obtained.

Special honing equipment results in diametric size being held consistently to 0.0002 or 0.0003 in. in volume production. Geometric tolerances are now also held to millionths of an inch in production.

Automatic size control during honing eliminates the need for having the operator check each part and rehone parts to bring them to size. The method includes automatic expansion and collapse of the tool with compensation for abrasive wear.

Automatic size control has made multiple spindle honing operations practical, and has led to automatic handling, such as loading and ejecting of the work piece. Automatic inspection also is practical with certain types of honing equipment.

To cope with the trend to higher production, greater accuracy and the growing need for automation features, the broaching industry is constantly on the lookout for better means of meeting these demands.

1 STANDARD machine tools like this 5-hp plain milling machine show steady performance gains.

2 MODERN high speed hobber is representative of constant changes to permit faster cutting.

3 FAST, flexible contour lathe is one answer to the demand for accurate repetitive turning.

4 SMOOTH hydraulic power aids the accurate reproduction of contours in diesinking operations.

3 The New Britain Machine Co.



4 The Cincinnati Milling Machine Co.



One of the most significant developments in recent broaching requirements is the introduction of automated features which enable broaching operations to be tied-in with other machining operations.

Greater cutting speed requirements are being met by the introduction of mechanical drive machines, both horizontal and vertical types. Applications especially adapted to this type of equipment have achieved noteworthy economies in production.

Higher rams speeds, however, are not the only answer to greater production for every part and for every user. Major improvements in parts handling, better fixturing and, most important, tailoring the broach installation to the job, provide major opportunities for improved production results.

In recent years, broaching has become an important production process. Internal broaching machines are finding increased use where the amount of metal to be removed is small and unusual accuracy is required, particularly if special shapes are involved.

Big external broaching machines have become key operations for removing comparatively large amounts of metal for gray iron castings, usually in a single pass.

The metalworking industry's need for reliable equipment for drilling and finishing holes, often to very close tolerances, is practically insatiable. Multi-tooled, highly accurate drilling machines, special reamers and tappers, and jig borers, spacers and precision boring machines have been developed to meet this requirement.

Many plants and shops have developed their own special heads combining, for example, drilling, counterboring, tapping and reaming in a single machine. The use of multi-tooled machines is growing at a tremendous rate.



6 The Warner & Swasey Co.

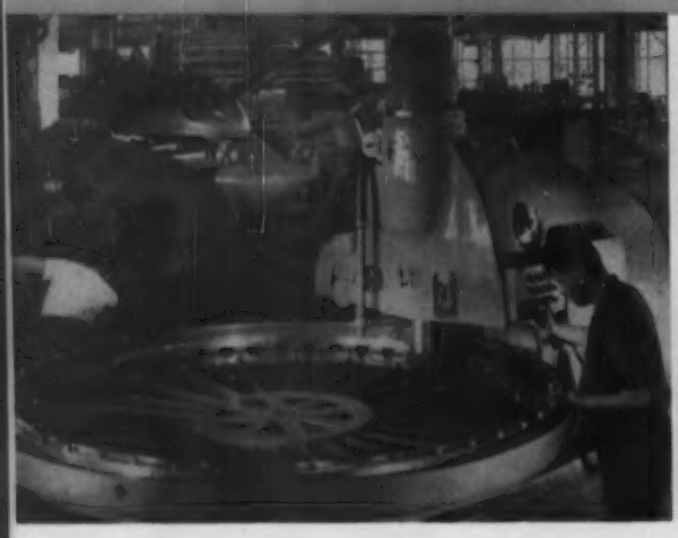
5 TANK production and dependable performance get a boost from this modern 120-in. gear shaper.

6 PRECISION tapping and threading machine keeps production and quality at superior levels.

7 THREAD chasing with a 13-in. toolroom lathe having 4-way rapid tool traverse.

8 AUTOMATIC saw cuts disks quickly and to precise thicknesses from tough 6-in. bar stock.

5 The Fellows Gear Shaper Co.



7 The Monarch Machine Tool Co.



Meanwhile, new standard drilling machines have combined higher rates of operation with improved accuracy and special safety devices, power clamping and other features.

The development and introduction to industry of the spacer and jig borer for accurate hole locating now make it possible to make interchangeable parts without jigs.

Multi-station automatic drilling machines are a good form of automation since the part to be machined is loaded at the loading station and indexed around the machine, having successive operations performed at each station.

In many cases, heads are incorporated for drilling, tapping and reaming parts which have been bored and turned in previous operations on the same machine. These heads are often the multiple-spindle type which machine a series of holes in one operation. This type of multi-station equipment represents a well-defined trend toward getting more operations per machine.



The remarkable speed and accuracy of the modern h'gh speed boring mill has given the production department of metalworking plants another highly efficient tool. Holes can now be drilled faster and straighter and with greater accuracy so that, in many instances, secondary operations such as reaming are eliminated. The use of multiple heads has increased still further the efficiency of modern boring mills.

Using modern, rigid milling machines equipped with properly designed tools and effective coolant systems, milling speeds can now be pushed substantially higher than the rates used in most production shops.

Carbide tipped cutters have been used to mill steel heat treated to hardnesses up to 400 BHN. Climb milling is gaining acceptance and will undoubtedly be more widely employed.

Contour milling and multi-spindle cutting have increased rapidly during the past few years. The use of special attachments now makes it possible to cut irregular shapes in three different dimensions, if desired.

Tables that automatically lower their position to provide clearance on the return stroke are a fairly recent development. Automatic cycling has been provided in a number of recent installations.

The addition of reliable duplicating equipment has extended the application of milling to many difficult die sinking jobs. A much publicized recent development is the use of high speed milling to hog out the ribbed section of an airplane from a huge block of aluminum,

Many significant developments which have cut gear production costs and improved gear quality have been made since World War II. The need for high speed marine gears immediately following the War led to the development of huge new rotary gear shaving machines for finishing the teeth on 180-in. diam herringbone marine gears to tenths-of-a-thousandth tolerances.

The advent of the automatic transmission for automobiles spurred a host of new developments in the gear production field. Automatic transmissions, because they had more gears than the handshift models, put gear production requirements rates into quantities never before needed. Close tolerances, never required in hand shifted transmissions, made new basic production concepts and equipment a necessity for automatic transmission gear production.

Develop new gear broaches

One of the early requirements in the post war automatic transmissions as well as in overdrive transmissions was for internal helical and spur running gears. New broaches were developed which allowed internal spur and helical running gears to be produced on conventional broaching machines to extremely close dimensional and finish tolerances without any subsequent tooth finishing operations.

A new type of rotary gear shaper was developed to generate internal helical gears made as integral parts of brake drums in the new automatic transmissions. High speed gear shapers and hobbing machines embodying entirely new basic design features upped production rates for both spur and helical gearing.

New concepts were also applied to the design of rotary gear shaving machines. Diagonal rotary gear shaving machines were developed which doubled production rates over those possible with earlier models using other methods. A new internal gear rotary shaver was developed within the past year designed exclusively for the shaving of internal gears up to 12-in. diameter.

In the past five years, the gear production field has been literally revolutionized as far as gear loading and unloading, sound testing and inspection are concerned. For as the gear produc-

tion machine cycles became shorter and shorter, so the loading and unloading problems become greater and greater.

Planers and shapers, like other modern machine tools, have been given greatly increased power, better controls and improved flexibility of operations. Rapid traverse, better clamping and improved lubrication have accompanied better design of the base, tool holders and fixtures.

As in other metal processing, the use of tungsten carbide tooling has made possible much higher feeds and speeds on planers and shapers. Improved performance has, in turn, created a demand for better drives, faster controls and greater rigidity.

A considerable amount of research work is being carried out on machinability, aided by two relatively new but highly effective research tools —the high speed camera and the newly available radioactive elements.

The probability that microstructure largely determines tool life, permissible removal rate and finish is now generally accepted. Studies recently conducted by the Air Force have added significant confirmation to this theory which is now shared by many of the country's outstanding metallurgists.

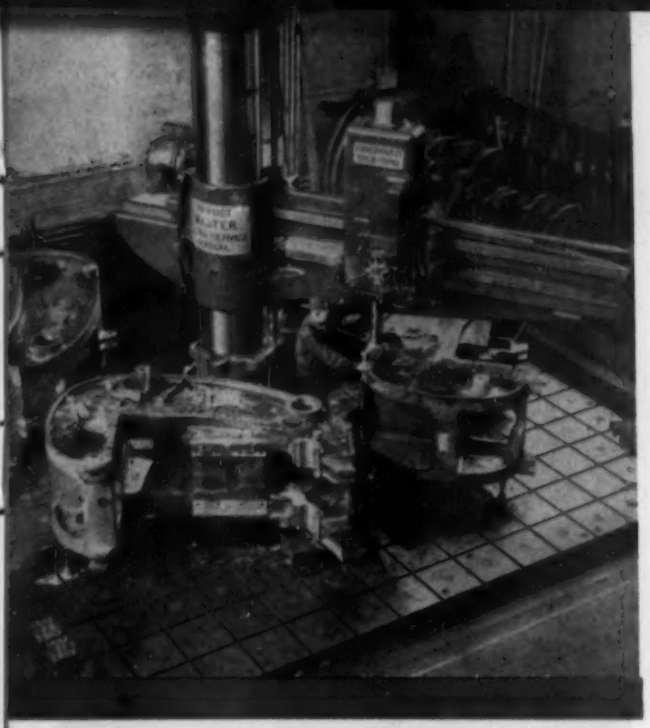
High speed machining, particularly for steel cutting, has been intensively studied. So far a number of automobile production parts having closely controlled microstructures have been turned at rates as high as 1200 fpm. However, as yet this is not typical of prevailing automotive practice.

Circular saws, hand saws, abrasive cut-off-wheels, friction saws and flame cutting techniques have undergone extensive improvement in recent years.

A number of available saws now provide reliable and efficient automatic bar feed. Also, saw-







9 HONING machine setup for continuous finishing of flat surfaces on critical automotive parts.

10 VERTICAL turret lathe accurately machining an aircraft engine diffuser assembly.

11 RADIAL drill puts speed, accuracy and power to work in machining big steel castings.

12 CARBIDE tooling helps this 6-spindle automatic produce 300 threaded valve centers per hour.

13 SHAFT grinding to precision tolerances on a modern, high speed, 12 x 36 in. universal grinder.

ing may now be combined if desired with other operations including machining operations such as broaching and milling.

The use of specialized saw blades for certain operations has undoubtedly extended the life of the blades as well as provided much desired accuracy. Controls, adjustment facilities and coolant pumps have undergone considerable redesign and improvement. New circular blades, some with inserted teeth, are now available.

Lathes flow metal

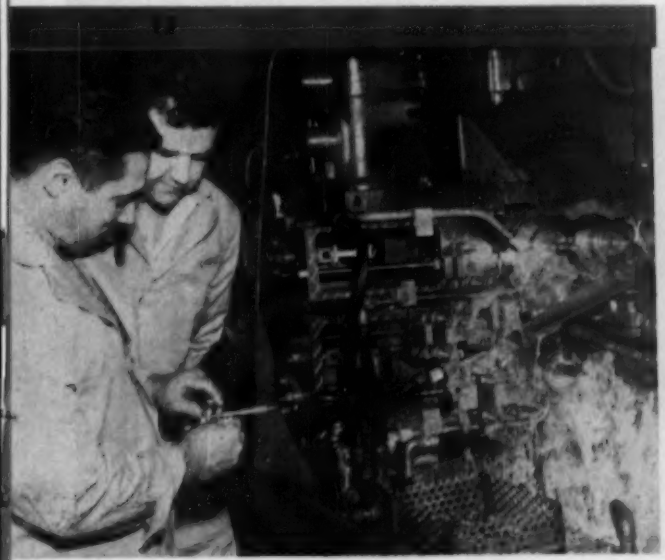
Most of the recent effort at developing spinning equipment has been directed at removing skill and muscle from the job.

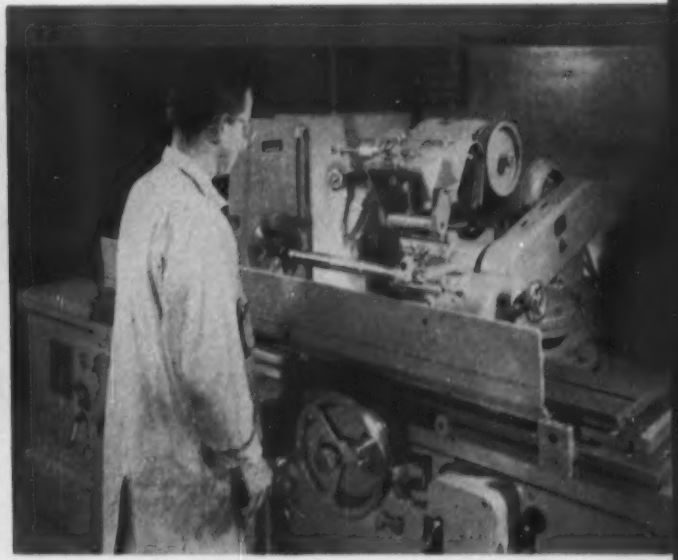
Automatic spinning lathes introduced recently differ basically from conventional spinning equipment. Using a hardened and polished roller, pressure is applied in a continuous spiral manner, gradually and accurately flowing a metal blank to the shape of a mandrel. The new machine permits the forming of conical or cylindrical sections or combinations of these two and other complex shapes.

With this machine, the diameter of the blank is exactly that of the finished part. Thickness is heavier than required in the finished wall. The additional metal flows into the extended shape. The method increases the strength and hardness of the metal worked. Effects on the granular structure of the metal are comparable to those achieved by rolling.

The development of electrical discharge machining makes it possible to cut the hardest materials accurately to shape without raising the temperature of the tool or the metal appreciably. The tool never touches the work, and comparatively little high frequency electricity is used.

One of the most promising applications is in





"grinding" carbide tools. Outstanding process advantage is that it removes metal from fully hardened work which requires no final heat treatment or grinding. This interests die makers who produce complex forming, drawing, compacting and extrusion dies.

Ultrasonic machining is also attracting attention for its ability to grind, bore, thread and machine hard and brittle metals and non-metallic materials. With this technique a workpiece and an inexpensive, shaped steel tool are immersed in water which contains a quantity of fine-grained abrasive.

No stress or heating

The steel tool vibrates at high frequency through an amplitude of a few thousandths of an in. The abrasive machines or grinds the tool shape in the workpiece. Initially used for machining intricate dies, and for grinding chip breakers in carbide tools, the process is being extended to other applications. It involves very low stress, no local heating, and will not alter the physical or chemical characteristics of the work being machined.

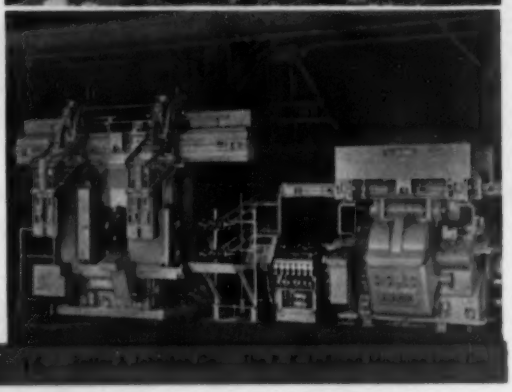
The science of machining metals with the aid of coolants has gone through a variety of progressive ideas in the past 40 years. These include both straight cutting oils and water soluble or emulsifiable oils.

Improvements are marked by the development of water soluble oils and emulsions. The first water soluble oil was merely an addition of soda ash to water to retard rust and, at the same time, permit the use of water with its excellent heat dissipating properties. Water soluble oils having properties of a lubricating nature are another sign of progress, and so is the development of a water soluble transparent solution which permits greater work visibility through the coolant.









14 FINISH grinding the OD of a compressor rotor on a 30 x 48 in. hydraulic universal machine.

15 JET engine exhaust cone is cold formed between lathe roller and a rotating mandrel.

16 Top: TURRET lathes handle a wide variety of work. Bottom: AUTOMATED turning equipment machines 55 shell-cast V-8 crankshafts every hour.

17 HIGH speed planer with 48-in. wide table takes heavy cuts on steel with aid of carbide tools.

18 TRANSFER MACHINE has 56 stations, performs 104 machining, handling and inspection jobs.

19 OPENSIDE heavy duty planer with 30-ft table was built for high speed work on large jobs.

A most recent development is a soluble oil with fortified base, high in saponifiable content, antiseptic value and extreme pressure characteristics, yet miscible with water. Because of this dilution with water, sizable economies can be effected over straight oils or paraffine dilutions of heavy black bases. By varying the dilution, a wide range of machining jobs can be done with one product.

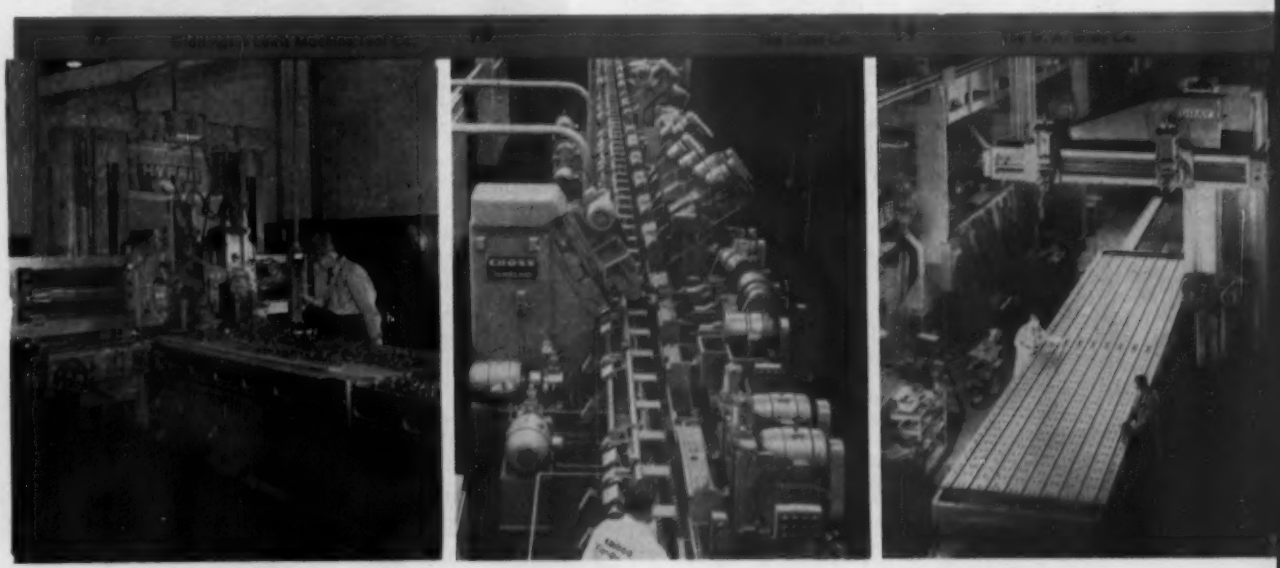
Cemented carbides gained new stature in the metalworking industry in the last 10 years. Their recognition as superior cutting materials had a profound influence in the designing of machines with more horsepower and rigidity for optimum performance of the tools.

Carbides have brought about many improvements in steel cutting practice. The technique of holding cutting blanks mechanically opened up new production possibilities through trepanning and gun drilling, advanced cast iron drilling methods, and extended milling and planing.

Carbides cut downtime

The strength of carbides also was responsible for the indexing technique associated with mechanical holders used in heavy machining applications where rigidity is needed, and where brazed joints were not strong enough to do the work. Carbide tools, with several cutting edges that could be ground in one operation, increased production, reduced downtime as well as tool inventories. They also led to the lower cost throw-away type tools when the harder grades of carbides were developed.

With the greatly increased power of modern machine tools to generate chips, chip handling has become an increasingly important problem in the high production shop. Improved machine design, avoiding pockets and openings where chips can accumulate, are now standard practice for machine tool builders.



MACHINE TOOLS...

the future

SECTIONALIZED automation in which parts of an automatic transfer machine can be isolated for downtime periods while the rest of the line continues to produce is one of the most recent developments in automation. While the theory of the sectionalized transfer line is not yet accepted by the entire high production industry, sectionalized automation appears to be gaining in favor.

Eventually, it is predicted it will be possible to remove a machine from a line completely and permit the rest of the group to function.

Still another significant development in the high production machine tool industry is the growing use of modular construction. That is to say, more and more standard units are being used in the big specialized machines.

By combining modular construction and automation, it is claimed that both provision for future growth and change and increased flexibility are achieved in specialized, fully automatic machine tools. Tooling, it is contended, can progress at minimum cost from low or medium volume to high volume. Protection is also provided against obsolescence for the modern mass production plant.

Standard machine tools in the future will continue to comprise the greatest number of metal cutting tools in metalworking plants. These machines will be built with more automatic features, greater rigidity, higher accuracy, and faster speeds.

The dividing line between a standard machine tool and a special machine tool will become even less marked in the future. Standard machines are now becoming increasingly capable of performing specialized operations while specialized machine tools, so-called, are becoming more standardized in many construction details.

Among a long list of future developments in turning that appear to be imminent, the increased demand for special contouring and duplication is among the most insistent. Also a substantial increase in the demand for automatic cycling and equipment having automatic gaging is anticipated.

Lathes will inevitably become more fully automatic. Feeds will be more readily adjustable. The use of automatic loading and unloading mechanisms, particularly by the high produc-



tion industries, is expected to increase greatly.

New tracer units will undoubtedly be simpler than the mechanisms in use today. Improved accuracy is the constant forward objective of the builders of such devices. Future turning machines will have greater rigidity to meet the growing requirements for higher feeds and speeds, stepless feeds and speeds, faster and easier chucking. New devices for breaking and clearing chips and better lubrication are additional improvements that have already progressed beyond the drawing board stage.

As job runs are shortened by faster cutting speeds, there will be greater need for faster tool and attachment changes in multiple-spindle automatic screw machines. Faster means of machine adjustment will be necessary. There will be more extensive use of automatically operated stock reel loaders and reels will be more adjustable to various stock lengths.

Automatics with cemented carbides definitely have a promising future. Automatic machine design will keep abreast of the constant improvements being made in carbide tooling.

The use of more automatic loading and unloading devices for grinders is inevitable. The development of still higher grinding speeds will result from the introduction of grinding wheels having better wear resisting properties and resistance to breakdown.

Lapping will continue to be used where exceptional surface requirements have to be met. Some recently developed lapping machines permit the attainment in production of surfaces that were heretofore considered impractical.

Honing is undoubtedly only in its infancy. Even greater strides will be made in the future as the need for greater precision is recognized on a greater variety of parts.

The trend toward sectionalized, carbide broaches for high production operations on cast iron is well established. There is also a trend in the direction of automatic fixturing and automatic cycling. Automatic feeding devices are being developed for a limited number of high production broaching applications.

The development of automatic controls has, of course, paralleled the adoption of other automatic features in broaching machines. Longer stroke machines are coming. The possibility of varying the cutting speed during the stroke has been considered.

New overload protective devices will undoubtedly be available in drilling equipment of the future. The development of automatic cycling features has already begun.

It appears inevitable that industry will demand further application of modern drilling, tapping and reaming techniques to add to the functions of machines doing other operations such as boring, turning and milling. Future requirements will undoubtedly include the development of means of automatic measuring and quality checking.

With the increased power being provided in the newer boring machines, still further increases in feeds and speeds are becoming available. Controls of operating feeds and speeds are becoming increasingly responsive and flexible. Better chucking is under development. Facilities for chip disposal will undoubtedly be improved as compared with existing machines.

That the maximum rate for milling has not been attained is readily evident. Milling rates are being raised constantly as better machines, improved controls and more efficient tools are made available.

Automatic controls and automatic cycling are moving up fast. Improved clamping methods are under constant development. New table designs, including indexing, dial-type tables, are receiving serious consideration.

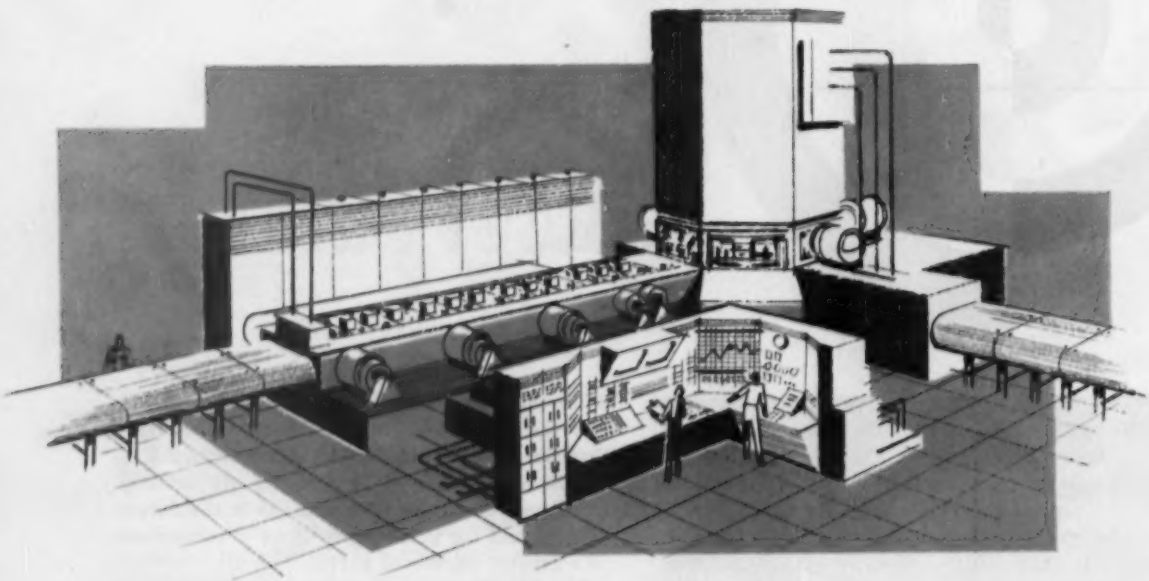
Tracer-controlled millers will continue to find an important place, both in peacetime and defense industries. While punch card or punched tape or other types of automatic, remote control may come eventually, the use of such equipment in sizable quantities appears to be, at the present, quite a few years away.

There seems to be no letup in the progress that has been and will be made in the gear production field. Lower gear cost and higher quality are consistently being achieved and will be bettered. Great strides in gear production have been made just recently with the application of full automation.

Full automation in the gear field has seen the adaptation of hopper feeds, motor-driven automatic gear gaging and sorting machines and automatic loaders to standard machine tools.

Considerable progress has been made toward achieving increased production and lower maintenance expense on planers and shapers. Higher table speeds are already here. Improved tool holders and fixtures have been designed. To promote rigidity and add strength, welded structures are being substituted for castings by some builders. The use of more "gang" tooling on both planers and shapers appears certain.

Trend in carbide materials in the next 10 years will be toward the use of elements cheaper than tungsten and other materials now in use. The use of more oxides and trace element compositions will be stepped up.



AUTOMATED MACHINE TOOLS of the future may well be designed to incorporate the space saving advantages of dial-type machines with the ability of the straight-line transfer machine to provide more work stations. In the machine shown above, automatic positioning, cleaning, assembly and perhaps even heat treating might be performed, as well as machining.

Through adoption of the principle of sectionalized automation it might even be possible to bypass either the transfer or dial-type sections for some parts and combine them for others. The ideal unit would permit substitution of standard, interchangeable units for flexibility and to lessen the effects of obsolescence.

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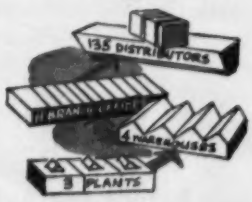
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Quotes: 1855 — 1955

Abstracts from past issues of THE IRON AGE, *selected for their flavor, and with some regard for whimsy:*

Tungsten Tool Steels

Metallic tungsten is so hard that it scratches glass easily, and so slightly fusible that it cannot be melted in an ordinary furnace. On the other hand, it may be mixed with iron by fusion in all proportions, and the larger the quantity of tungsten, the harder and more difficult to melt is the compound. Like carbon, it appears to diminish the ductility of iron both when hot and cold, but especially when cold. It is then possible, by melting together tungsten and iron, to obtain a steel much harder than one with carbon alone, without the danger of incurring at the same time an excessive fragility when cold, or difficulties of working when hot.

For uses which require a special degree of hardness, a steel rich in tungsten, called "special steel," is frequently employed. Thus a fine Sheffield steel for lathe tools, according to an analysis made by Baron Barnekow [would contain tungsten].

May 4, 1876

Chicago Grows

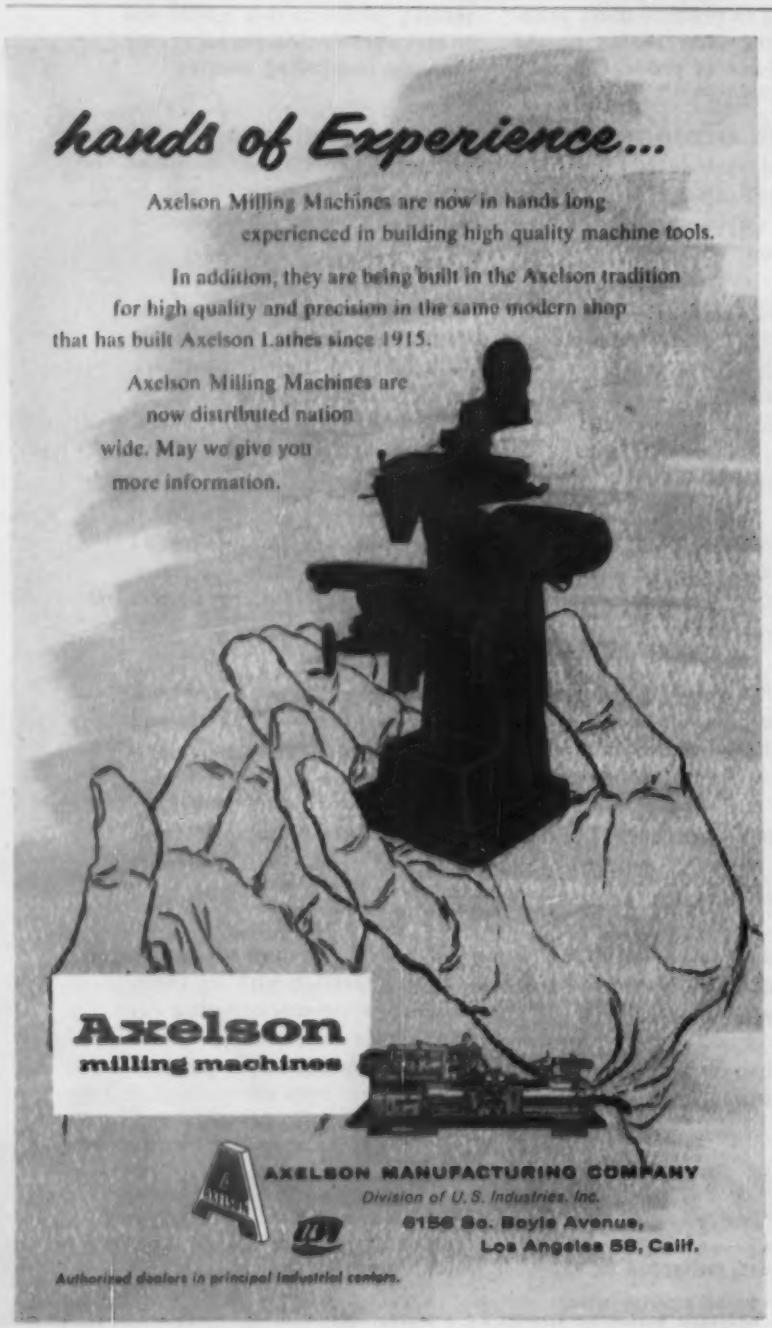
"Chicago is enjoying an extraordinary industrial development in the department of manufactures. The city now has nearly 3000 factories, employing over 60,000 persons, and turning out goods during a year worth over $230,000,000. . . ."

Jan. 8, 1880

Long Before the Auto

The Detroit Journal of Commerce says: "A lapse of a few years and the energy and enterprise of our manufacturers have made gigantic strides toward elevating Detroit to her present proud position among the manufacturing cities of the United States, for she did not cease to push forward with unrelaxed vigor, until she is today the great manufacturing city of the West; and probably equalled only by the second manufacturing city of the world—Philadelphia. While other cities have been making continual empty noises, Detroit has quietly but steadily pushed forward the car of progress and is destined at no distant date to surpass the expectations of the multi-sanguine until she will stand without a rival."

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Pays for itself in 3 Profitable Ways:

1. **TOP SCRAP VALUE.** Uniform short shoveling turnings produced by an American bring up to $4 per ton more than regular machine shop turnings.
2. **INCREASED CUTTING OIL RECOVERY.** Up to 50 gallons per ton are released from turnings reduced in an American.
3. **EASIER HANDLING, STORAGE.** American-reduced turnings require but a fraction of the usual storage space .. are easily briquetted.

Available in 1 to 10 tons per hour capacities to meet your needs. WRITE today for the complete American profit story.

American PULVERIZER COMPANY

1439 MACKLIND AVE. • ST. LOUIS 10, MO.

To Make Emery Wheels

The old hosiery mill, at Meredith Village, has been leased by the American Twist Drill Co., of Woonsocket, R. I., for a term of ten years. They intend manufacturing solid emery wheels, automatic knife grinders, emery wheel machinery and mechanics' tools. They will start up about the first of next month.

Apr. 15, 1880

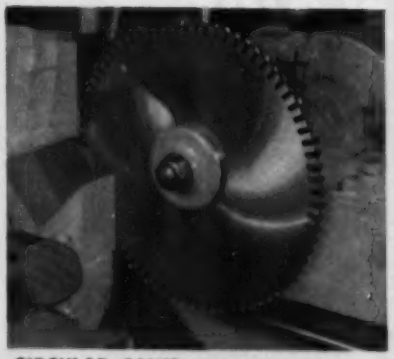
Friction Saw in 1871

The Phoenix Iron Company are fixing up a circular saw in their machine shop, intended for sawing large beams and shafts of iron in a perfectly cold state. Upon inquiry we learned that the saw is intended to make 3000 revolutions per minute—will have no teeth, being perfectly smooth, the work to be accomplished totally by friction.

June 29, 1871

Mechanical Man Is Steam Powered

Mr. Ladock Deddrick, a Newark machinist, has invented a man, that moved by steam, will perform some of the most important functions of humanity, standing upright, walking or running, as he is bidden in any direction and almost any rate of speed, drawing after him a load whose weight would tax the strength of three stout draft horses. The man stands seven feet and nine inches high, the other dimensions of the body being correctly proportioned. He weighs 500 lbs. Steam is generated in the body or trunk, which is nothing but a 3 hp. engine, like those used in our steam fire engine. The legs which support the automaton are complicated and wonderful. The steps are taken very naturally and quite easily. Each step or pace advances the



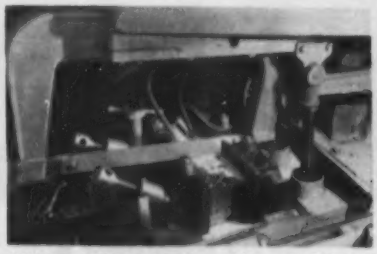
CIRCULAR SAWS. Simonds makes all three types — Inserted Tooth, Segmental, and Solid Tooth Saws. A "right" saw for every metal cutting application.

SPEAKING OF NEW CARS

SIMONDS Helps to Reduce the Cost of cars* like this and yours

Few of us could afford new cars like this without the magic of mass production. One of the things that makes mass production possible is the low cost, dependability of Simonds cutting tools and die steels. Simonds quality has long played an important part in the automotive industry. Carefully maintained by 100% quality control from Simonds own Steel Mill through every step of manufacture in Simonds famous "Windowless" plant, Simonds unique quality keeps production lines moving, unit costs down.





HACK SAW BLADES. Simonds "Red End" Hack Saw Blades (Power and Hand) last uniformly longer, cut metal cutting costs.



BAND SAWS. Simonds makes all three types — Regular Tooth, Sabre or Skip Tooth, Spring Temper — to provide the best blade for every application.



FILES. Mechanics report Simonds "Red Tang" Files feel better, file better, last longer — cut more metal per filing dollar. "Prover-tested" for grade A quality.



SQUARING SHEARS. Simonds single edge shear outlasts other types, costs less for shearing thin sheet metal. Made by Simonds exclusive "Tungaweld" method.



DIE STEEL. Simonds 1001 sizes of flat-ground tool and die steel save more time and money in the toolroom — give excellent results on every job.

SIMONDS
SAW AND STEEL CO.
FITCHBURG, MASS.

For Fast Service from Complete Stocks

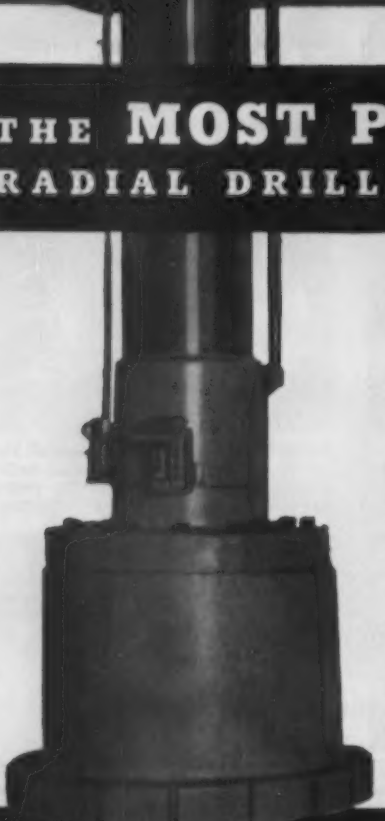
Call your SIMONDS Industrial Supply DISTRIBUTOR

Factory Branches in Boston, Chicago, San Francisco and Portland, Oregon
Canadian Factory in Montreal, Que., Simonds Divisions: Simonds Steel Mill, Lockport, N. Y.
Simonds Abrasive Co., Phila., Pa., and Arvida, Que., Canada

FOR 80 YEARS **CINCINNATI**
BICKFORD DRILLING MACHINES
HAVE EFFECTED SAVINGS
IN THE PLANTS OF AMERICA



THE MOST POWERFUL
RADIAL DRILL IN AMERICA



This standard 12-foot Master Super-Service Radial with 26-inch diameter column is a specialized portable type, built to suit the needs of one of America's largest turbine manufacturers. Here is an example of the correct application of modern cost-cutting equipment.

Let us work with you on your drilling problems, for our broad line and long specialized experience can effect worthwhile savings for you.



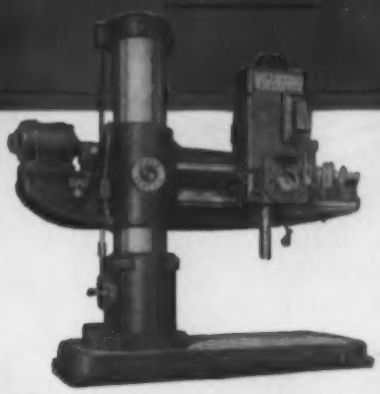
CINCINNATI
BICKFORD

The right
Cincinnati BICKFORD
will do your job better

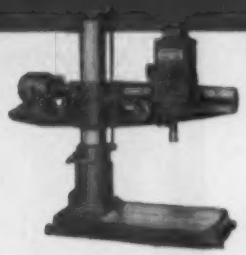
YOU CAN SELECT FROM
the extensive variety of sizes and types of drilling machines . . . developed over a period of
80 YEARS OF SPECIALIZATION



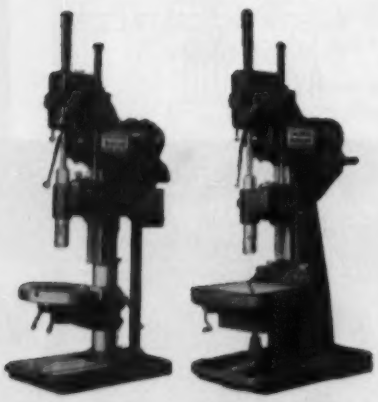
The SUPER SERVICE Master Radial Drill is built in 7′ to 12′ arm lengths and in 22″ and 26″ diameter columns. This machine has 36 speeds and 18 feeds powered by motors from 20 to 40 HP. The most powerful radial drill built.



The 36-speed 18-feed SUPER SERVICE Radial Drill is furnished in 13 different standard sizes, ranging from 3′ to 8′ arm lengths and 11″ to 19″ diameter columns. Driving motors are 7½ to 20 HP.



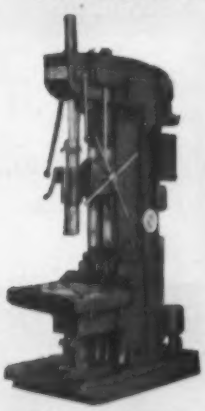
The 9″ Diameter Column SUPER SERVICE Radial Drill, designed for fast, easy handling, is built in either a 3′ or 4′ arm length with 9 speeds and 4 feeds powered with a 3 HP driving motor.



The SUPER SERVICE General Purpose Round or Box Column Upright Drilling Machines are furnished in 21″, 24″ and 28″ sizes. From 9 to 12 speeds and 4 to 9 feeds. The machines are powered by either 3, 5, or 7½ HP motors.



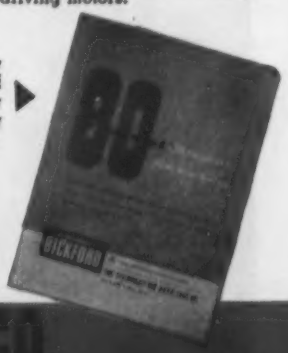
The new SUPER SERVICE Precision Drilling Machine is especially suited to operations in conjunction with the Bullard Spacer for interchangeable production without the delay and expense of costly jigs and special tooling.



The SUPER SERVICE Direct Drive Uprights have the adaptability of general purpose drilling machines but simplified for mass production. They are furnished in 21″, 24″ and 28″ sizes with 3, 5, 7½ or 10 HP driving motors.

What users say!

This booklet is a record of savings in many plants—and is of interest to all users of drilling machines. If you desire a copy please write for "80-year Anniversary Booklet".



RADIAL AND UPRIGHT DRILLING MACHINES

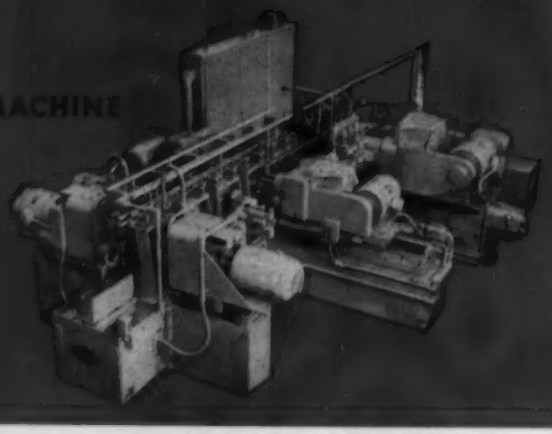
THE CINCINNATI BICKFORD TOOL CO.
Cincinnati 9, Ohio, U.S.A.

10 Station Automatic In-Line

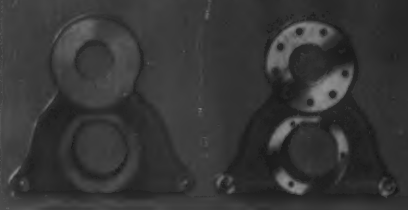
BAKER TRANSFER MACHINE

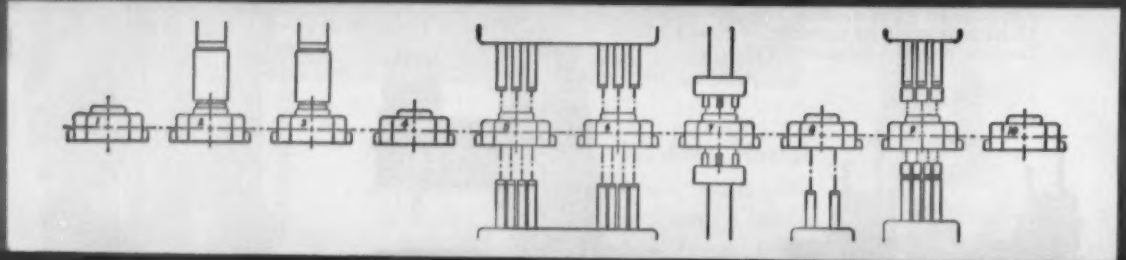
Performs Multiple Operations on Tractor Housings

THE MACHINE



THE PART





THE OPERATIONS

STATION NO. 1
LOAD 1 PART

STATION NO. 2
UNIT NO. 1
COMB. SEMI. FIN. BORE 5.165 & 3.249 & 2.861 DIAS.
COMB. SEMI. FIN. BORE 4.425 THRU BOTH WALLS

STATION NO. 3
UNIT NO. 1
COMB. FIN. BORE 5.180 & 3.264 & 2.876 DIAS.
COMB. FIN. BORE 4.440 THRU BOTH WALLS

STATION NO. 4
IDLE

STATION NO. 5
UNIT NO. 2 "U" DRILL 5 HOLES
31/64 DRILL 6 HOLES

UNIT NO. 3 31/64 DRILL 8 HOLES
21/32 DRILL 1 HOLE
"U" DRILL 6 HOLES
23/32 DRILL 1 HOLE

STATION NO. 6
UNIT NO. 2 ½ CHAMFER 5 HOLES
¾ CHAMFER 6 HOLES

UNIT NO. 3 ¾ CHAMFER 7 HOLES
13/16 CHAMFER 1 HOLE
½ CHAMFER 6 HOLES
23/32 DRILL 1 HOLE
COMB. COUNTERBORE
.796 & CHAMFER 1 HOLE

STATION NO. 7
INSPECTION

STATION NO. 8
UNIT NO. 4
.6910 REAM 1 HOLE
.8157 COUNTERBORE 1 HOLE

STATION NO. 9
UNIT NO. 5 7/16-14 N.C. TAP 5 HOLES
9/16-12 N.C. TAP 6 HOLES

UNIT NO. 6 7/16-14 N.C. TAP 6 HOLES
9/16-12 N.C. TAP 7 HOLES
½-14 N.P.T. TAP 2 HOLES

STATION NO. 10
UNLOAD 1 PART

Whatever Your Specific Job Problem, Consult Baker Engineers. Write

BAKER BROTHERS, INC., TOLEDO, OHIO

No matter what grinding method you use...





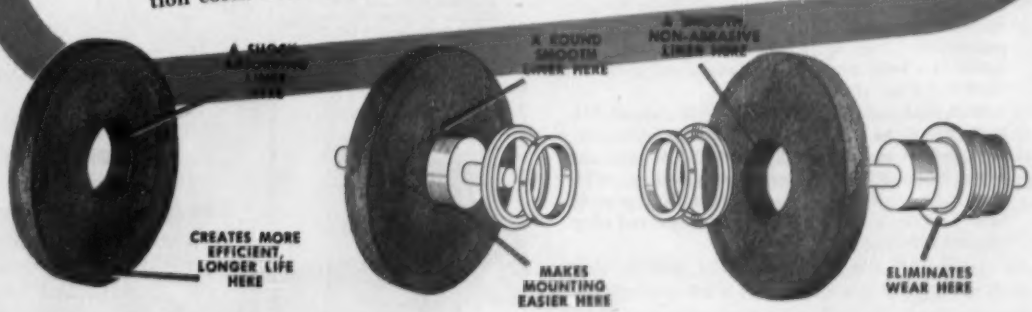
MID-WEST SNAGGING WHEELS ARE MORE EFFICIENT!

Here are the two big reasons for Mid-West's low-cost efficiency. They're ready to go to work for you!

1. Mid-West designed fiber-cushioned arbors minimize vibration. They're baked-in shock absorbers bonded in for life!

2. Mid-West snagging wheels' extra-tough bonds are designed especially for billet snagging, grinding of steel and alloy castings, and snagging operations on all types of non-ferrous metals and cast irons.

Here is real grinding efficiency that's bound to help you cut high production costs. For complete information—write, wire or phone today.



MID-WEST ABRASIVES

Executive Offices:
510 South Washington St., Owosso, Mich.
Factories: Owosso, Mich. • Rochester, Penna.



BURGMASTER* TURRET DRILLS

with POWER INDEXING

"Without the BURGMASTERS our costs to produce this part would have been almost prohibitive"

BURGMASTERS cut costs on drilling, tapping, threading, counterboring, countersinking, grooving, spot facing, form tooling, hollow milling, etc.

REPORT FROM:

AMPEX CORPORATION

REDWOOD CITY, CALIF.

ROLF J. GRUENSTEIN, Sup't. of Fabrication

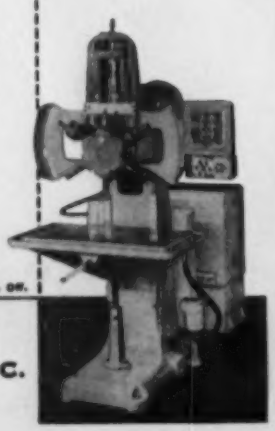
In the fabrication of Ampex CinemaScope Sound Systems used in theaters all over the world, one casting requires 42 separate drilling, tapping, reaming or counterboring operations. This includes drilling holes from #57 (.043 inches) to ¾ of an inch, and reaming holes to ½ inch with extremely critical dimensions on size and alignment. Without the BURGMASTERS our costs to produce this part would have been almost prohibitive. Other equipment to fill the same need would have been much more expensive and much less versatile for our type production.

We have found the following qualities of the BURGMASTER to be of definite advantage in the manufacture of Ampex CinemaScope Sound Systems and Ampex Magnetic Tape Recorders. High precision. Wide range of preselected speeds. Large adjustable work table. Low maintenance cost. Minimum time and effort required for set-up.

AVAILABLE IN:

- **Six spindle manual**
- **Six spindle, hydraulic, automatic**
- **Eight spindle, hydraulic, automatic**

Automatic hydraulic BURGMASTERS feature skip indexing, automatic cycling and infinitely variable preselective feeds. All BURGMASTER machines feature power indexing, pre-selective spindle speeds, very close pre-selective depth control.



Write for Bulletin No. 1A-6

*T.M. Reg. U.S. Pat. Off.

BURG TOOL

MANUFACTURING COMPANY INC.

P.O. BOX 49, GARDENA, CALIF.

body two feet and every revolution of the engine produces four paces. As the engine is capable of making more than 1,000 revolutions a minute, it would get over the ground on this calculation, at the rate of a little more than a mile a minute. As this would be working the legs faster than would be safe on uneven ground or on city cobblestones, it is proposed to run the engine at the rate of 500 revolutions per minute, which would walk the man at the modest speed of half a mile a minute. The fellow is attached to a common Rockaway carriage whose shaft serves to support him in a vertical position. To the soles of the feet spikes or corks are fixed which effectually prevent slipping. An upright post, which is arranged in front of the dash board and within easy reach from the front seats, sustains two miniature pilot wheels, by turning which these various motions and evolutions are directed. To prevent the giant from frightening horses, Mr. Deddrick intends to clothe it and give it as nearly as possible a likeness to the rest of humanity. The boiler and such parts as are necessarily heated are to be encased in felt or woolen undergarments. The cost of this first man is $2,000 through the makers, Messrs. Deddrick & Grass, who expect to manufacture succeeding ones warranted to run a year without repair for $300.

Jan. 23, 1868

Business Good For Illinois Plow Makers

The Grand Detour Plow Works, Dixon, is an immense and prosperous establishment, employing 75 to 100 hands, and turning out about 15,000 walking plows and 1000 gang and sulky plows a year. The proprietors are Cumins, Noble & Dodge. These plow works were established in 1858 by John Deere (now of Moline) in the village of Grand Detour, whence they were removed to Dixon . . .

Nov. 9, 1876

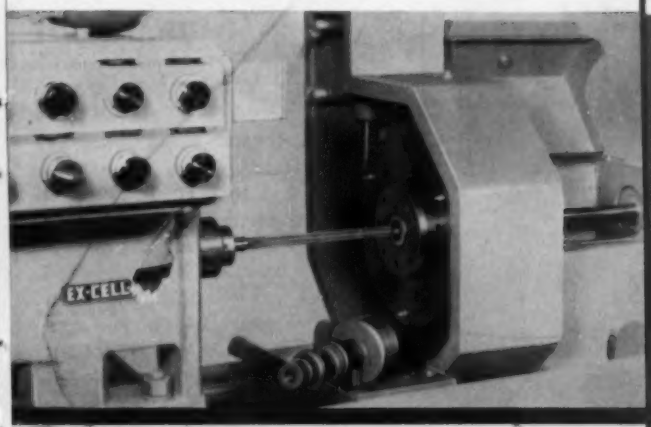


Photo with guards removed shows drill about to enter the guide bushing in the center of the chuck. Coolant oil under high pressure is directed through the spindle and drill, washing chips out of the single flute.



On this cast-iron distributor base, holes are machined straight and round within .0005"; diameter is also held within .0005"; finish does not exceed 15 rms. The hole is completed from start to finish in 30 seconds.

XLO

EX-CELL-O for PRECISION

Today's method by EX-CELL-O for reducing your costs

BOR-DRIL



for straight, accurate holes from solid with good finish—on standard machines



Equipped to Bor-Dril is this standard Style 2112-A, the smallest single-end model in the Ex-Cell-O Precision Boring Machine line. These machines are rigid, have easily adjustable feeds, vibration-free spindles. Multiple spindle applications for high production.

For more information on Bor-Dril, or for a quotation on a machine equipped for this work, call in your local Ex-Cell-O Representative or contact Ex-Cell-O in Detroit.

EX-CELL-O CORPORATION

DETROIT 32, MICHIGAN

MANUFACTURERS OF PRECISION MACHINE TOOLS • GRINDING SPINDLES
CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS
AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT

55-16





ways to cut costs
of drilling and tapping

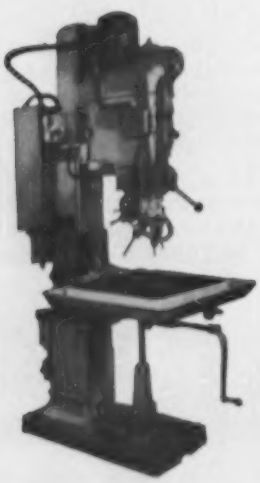
The H&F turret drilling machine, with preset depths, speeds and reversals—all attention-free during successive operating cycles—offers dramatic savings in:

1. Handling time.
2. Set-up time.
3. Tooling.
4. Maintenance.
5. Capital investment.
6. Floor space.

H&F Time Study #10 proves this versatile machine cuts handling time from 24% to 67%, assuming conditions most favorable to competitive equipment.

Write for H&F Time Study #10 and new bulletins.

H&F-s time saving turret attachment is separately available for attachment to standard drill presses . . . preset depth, speeds and reversals not included.



hf
HOWE & FANT

32 FITCH STREET, EAST NORWALK, CONN.

Well Abandoned

The Winchester Arms Company, of New Haven, have abandoned their attempt to bore an artesian well for water, after going down 2400 feet without securing a supply. The contractor [illegible] reached this depth six months ago, when some evil-disposed person dropped about 50 feet of steel-boring tools down the well, causing an obstruction which persistent efforts have since failed to remove. Scientists are at a loss to account for the absence of water at the great depth reached. The well is said to be the second deepest bore in this country.

Jan. 22, 1885

Labor and Wages

In Schuylkill, Northumberland, Columbia and Dauphin counties, Pa., there are employed in different capacities about the coal mines 28,816 men and boys. The last monthly reports of the mine inspectors show that in that time there were forty accidents and seven of these were fatal.

The laborers at Carnegie Bros. & Co.'s Union Iron Mill, at Pittsburgh, struck on Monday of last week for an advance to $1.50 per day, but the strike took place after they were laid off and discharged and other men put in their places at the rates demanded, $1.50 per day. It had been the expressed intention of the mill to pay the same rates as other mills were paying but these men stopped work before making the demand, and under the circumstances the mill refused to employ them longer, though paying the advance asked.

A novel suit has been begun at Pittsburgh, growing out of the discharge of a workman at the request of his fellow workmen. The discharged workman has sued the committee who requested his discharge, both in a criminal suit for conspiracy and a civil suit for damages.

Puddling at Vulcan Rolling Mill,



FULLER BRUSH SETS THE PACE

with Improved Power Brush Machines

Send coupon below for literature on New Machine

Make Use of FULLER BRUSH Engineering Service

NEW set-up opportunities, increasing production, are offered by the advanced design of this new Fuller Brushing Lathe and "universal" Work-piece Holder.

The lathe introduces a reversing spindle, which provides in the same cycle, a time-saving, two-directional brush attack. Also, 4 choices of power and a variable speed drive permit coordination of speeds to worn or small brush diameters — for maximum removal consistent with desired finish. Both off-hand and power manipulated applications can be arranged.

With the "universal" Work-piece Holder set-ups are given the most efficient position — vertical, horizontal, radial, angular or longitudinal — with power manipulation and reversing action. When desired this machinery can be equipped with controls for quality protection and for automatic cycling on production runs.

In addition to this new metalworking machinery, Fuller Brush has for many years engineered and built special brush machines for all industries. This experience is available for help on your unusual problems.



FULLANCHOR Super-Balance WHEEL BRUSHES . . . reduce vibration, improve work-piece finish, decrease brush wear . . . because brush filaments are precision-speced for precision-balance.

FULLER BRUSH

MAIL COUPON TODAY!



BONUS OFFER

We will give you, ABSOLUTELY FREE, this handy, time-saving slide chart that gives wheel brush specifications with a flip of the wrist . . . when you send the coupon for help with your brushing problems.

The Fuller Brush Co.
3628 Main St.
Hartford 15, Conn.

Please send me your Free Wheel Brush Selector and your literature on NEW Brush Machine. Some of our problems are checked at the right.

NAME_____ TITLE_____

COMPANY_____

ADDRESS_____

CITY_____ STATE_____

CHECK

- ___ Deburring broached parts
- ___ Deburring gear teeth
- ___ Deburring threads
- ___ Satin finish
- ___ Excess solder
- ___ Plastic flash
- ___ Blending pits and scratches
- ___ Surface uniformity
- ___ Polishing
- ___ (Other)_____

109 years of continuous service to industry

CIX

Specializing in standard and HY-TEN steels is a far cry from being "dealers in metals of all kinds"—the purpose for which Wheelock, Lovejoy & Company, Inc., was founded.

Our company became interested in high speed steels about 1900, even before these metals revolutionized machining. Ever since then, we have held a leading position as a distributor of alloy steels and have pioneered with our own special HY-TEN steels, "the standards of tomorrow."

All seven of our modern warehouses can promptly fill your requirements for bars, billets, and forgings in all sizes, shapes and treatments. This applies to standard AISI alloy steels and HY-TEN steels. Every warehouse, too, is staffed with expert metallurgists who are ready to serve you.



Write today for your FREE copies of Wheelock, Lovejoy Data Sheets. They contain complete technical information on grades, applications, physical properties, tests, heat treating, etc.

near you . . .

Warehouse Service—Cambridge • Cleveland • Chicago
Hillside, N. J. • Detroit • Buffalo • Cincinnati
In Canada—Sanderson-Newbould, Ltd., Montreal and Toronto

WHEELOCK, LOVEJOY & COMPANY, INC.
126 Sidney Street, Cambridge 39, Mass.

Chattanooga, is $5.50 per ton. Roll hands are paid Cincinnati prices. Puddling at the Roane Iron Works is $5.

Boiling at Richmond, Va., is $5.

The Hope Iron Company, Pottstown, Pa., increased the wages of their puddlers on the 2d of February from $4 to $4.25 per ton. Another increase is promised.

The committee of the workingmen at Bay View Rolling Mills, at Milwaukee, have had a conference with the managers and agreed upon a basis of wages for the ensuing year, fixed at the rate of $47 per ton, an advance of 27 per cent. over the rates of last year.

The packers in the window houses of Pittsburgh have been granted an advance of 10 per cent in their wages.

The pilers, draw-downs and laborers at the National Rolling Mill, Pittsburgh, are at present engaged in a strike for increased wages. The pilers get $1.50 and want $1.75, the drag-downs get $1.75 and want $2.25, and the laborers want a raise from $1.25 to $1.50.

The striking shovel makers at Hubbard, Bakewell & Co., Pittsburgh, got 10 per cent increase on Monday.

Feb. 12 1880

For the Coffee Break

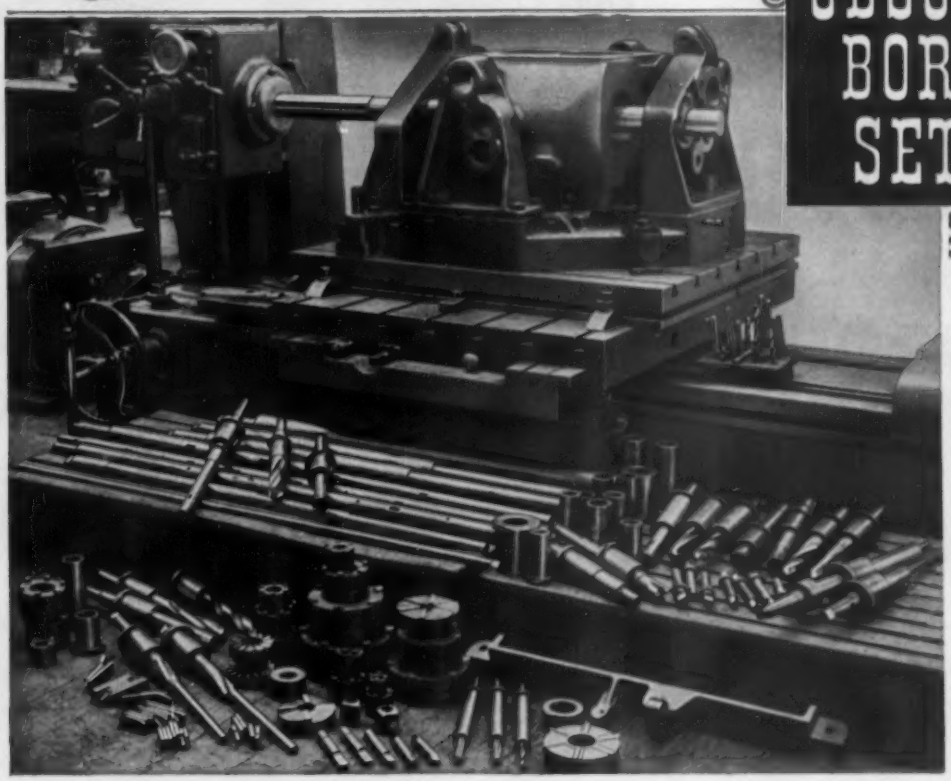
Fraser Bell & Loughran, 213 Pearl Street, exhibits Sargent's coffee boiler which, it is claimed, retains the aroma of the coffee while boiling and requires less coffee than other articles in that line.

The steam and aroma arising while boiling, coming in contact with the condenser, are immediately condensed and dropped back in the boiler and mix with the coffee. This operation continues until the water in the condenser becomes sufficiently heated to allow the steam to pass up the tube, raise the valve and blow the whistle.

Oct. 17, 1867

Here is a picture of an...

OBSOLETE BORING SETUP!



THIS PICTURE— taken in a well known machine tool plant illustrates the old method of boring turret lathe headstocks with a costly inflexible box jig and a mass of special tooling

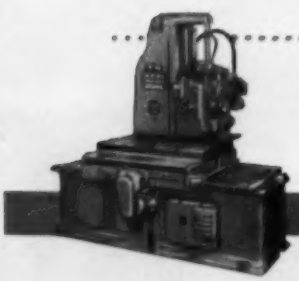
The Modern Method

"JIGLESS BORING" THE SAME PIECE ON A DE VLIEG JIGMIL

- Eliminated expensive boring jig
- Reduced machining time
- Improved accuracy with a resultant cut in assembly costs
- Permitted the use of simplified tooling



If your shop is burdened with costly boring jigs and special tooling, it will pay you to investigate the DE VLIEG SPIRAMATIC JIGMIL!



Come to Detroit... see a practical demonstration of the JIGMIL Technique . . .

DE VLIEG MACHINE CO.

A request on your company letterhead will bring a copy of our comprehensive Illustrated Catalog

50 lbs. oil pressure

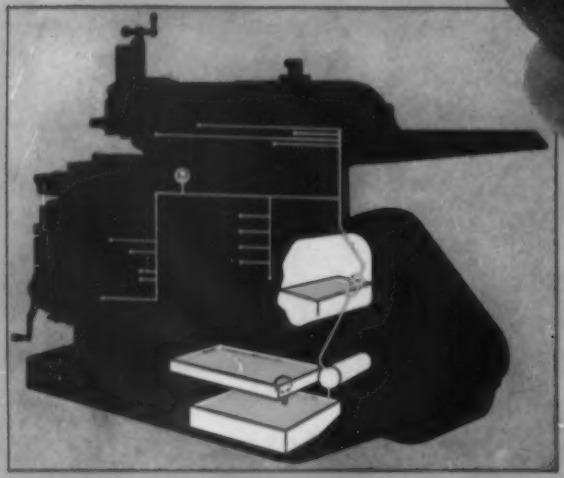
IS NECESSARY WITH A CUT LIKE THIS...

This tremendous cut demonstrates the extra strength, rigidity, and power in Cincinnati Shapers. It also demonstrates the ability of the 50 p.s.i. lubrication system to develop and maintain oil films under the heaviest loads.

Write for Catalog N-6.



Demonstration cut.
Actual size steel chip, 2" cut .030" feed Cincinnati 24" H.D. Shaper.



50 p.s.i. system includes 50 micro filter, settling basin and reservoir. Transmission runs submerged in oil.



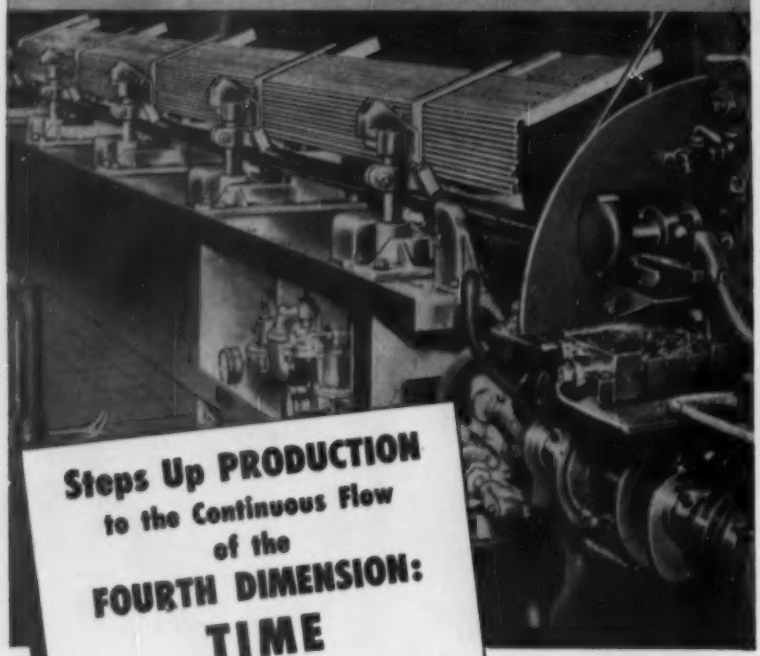
The Electro-Magnetic Brake and Clutch, with finger tip control, is a Cincinnati feature for speed and ease of operation.

THE CINCINNATI SHAPER CO.

CINCINNATI 25, OHIO, U.S.A. SHAPERS • SHEARS • BRAKES

CINCINNATI

Now... A Screw-Machine-Feed that BREAKS THE TIME BARRIER!



Steps Up PRODUCTION to the Continuous Flow of the FOURTH DIMENSION: TIME

EVERY TIME a screw machine cuts air... every time feed fingers are adjusted or replaced... every time remnant removal forces a shut-down — *that's time lost forever, never again to be made up in the production quota!*

In the modern Lipe Automatic Magazine-Loading Bar Feed, we present a continuous-feed mechanism that utilizes *every minute* of the working day for production...and still more production.

There's *No* cutting air. *No* feed fingers. *No* remnant problem. *No* minimum or maximum run. *No* limit on length of feed. *No* selective stock length requirement.

There IS a definite increase in production — up to 100% on some installations — *at least* 30% on *every one!*



Send today for FREE BOOKLET giving full details on Lipe's AML Bar Feed — today's big advancement in screw machine stock feeding. We will also supply name of your nearest distributor.

Lipe-ROLLWAY CORPORATION
Manufacturers of Automotive Clutches and Machine Tools
Syracuse 1, N. Y.

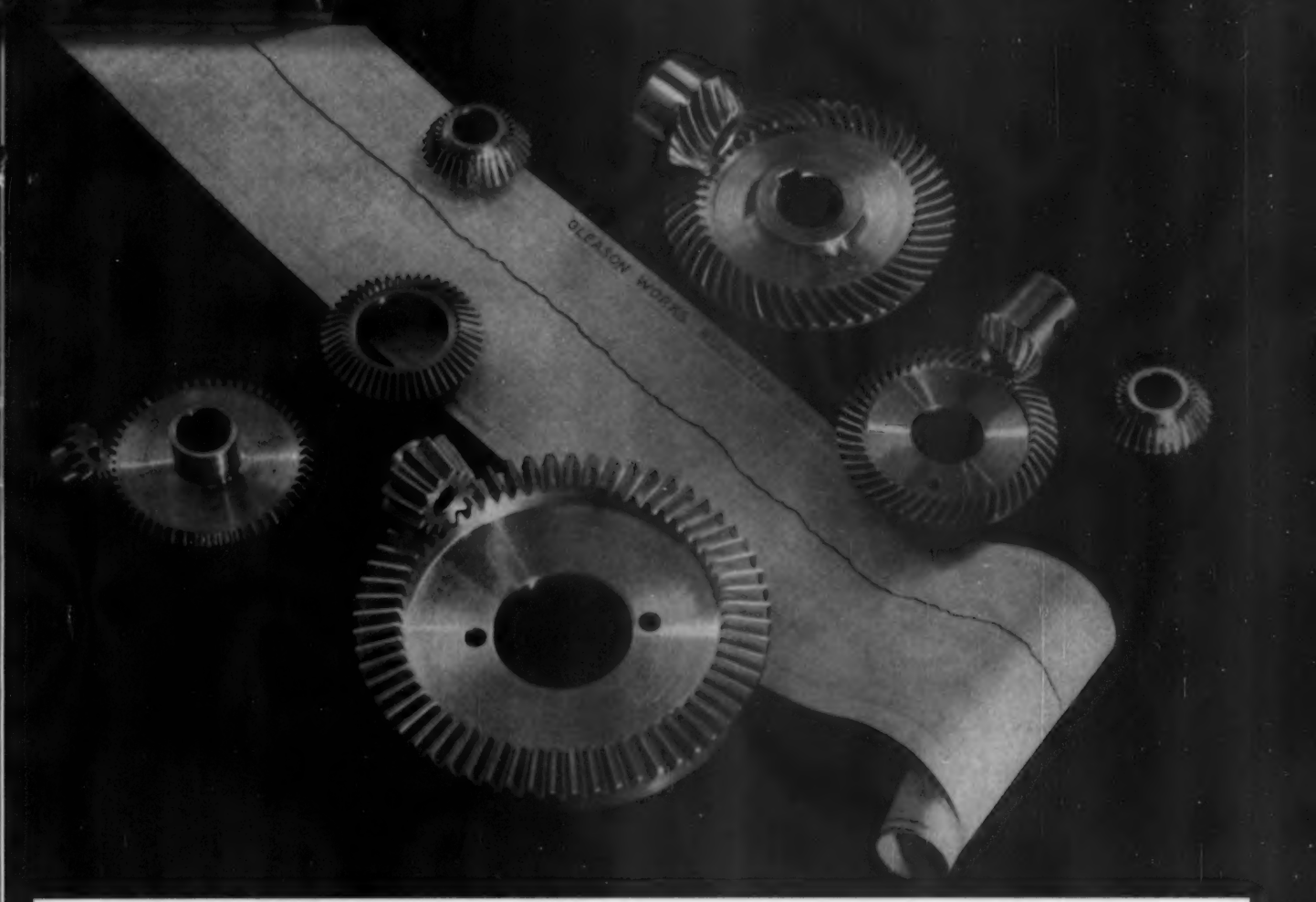
This Sounds Fishy

A submarine velocipede:—An inventive Frenchman has recently patented in France an extraordinary submarine boat which is formed like a fish and constitutes in reality a submarine velocipede. It is made of stout hide, strongly supported at the sides by very tough whalebone, and is from 16 to 20 ft. in length. Its exact shape is that of a young sperm whale. In the interior is a mechanism simple and ingenious by which the fins and the tail are moved on the plan of the pedals of a velocipede. The navigator lies on his stomach at full length and steers the boat in any direction, backwards, forward, up or down without fatigue and with scarcely any effort. As a provision against accidents, a long tube of gutta percha floats on the surface and communicates with the interior in case the supply of condensed air should give out, but this is almost unnecessary for simply by rising parallel with the surface another supply of air can be taken in which will last for a considerable time.

July 7, 1870

Locomotive Boom

Respecting the business of the last few months, similar statements are made at the official headquarters of all the locomotive builders represented in New York city. All continue full of orders, although the pressure upon them is not so great as a few months ago. The boom commenced in September or October, and continued with increasing vigor up to about February 1st, when it seemed to culminate. All the manufacturers were overwhelmed, the demands being far beyond their capacity. Orders meanwhile came in from all quarters, notably from the Northwest, partly for re-equipment, but largely for the extension of new lines of traffic. Of late the rapid advance in the prices of iron has operated as a check, a disposition



For *the best* in fine pitch gearing . . .

Gleason Works now offers complete production and testing facilities for *any* fine pitch spiral bevel, hypoid, Zerol® or Coniflex® gears.

Bevel gears produced and tested with Gleason equipment assure the highest degree of accuracy obtainable in angular motion transmission. And, with the new methods and improved design incorporated in these Gleason machines, fine pitch gears can be produced at a lower cost than ever before!

Generators and grinders

Three Gleason Generators cover the entire field of cut fine pitch bevel gears up to 4½″ diameter. These include the No. 2A, 103 Straight Bevel Coniflex Generators, and the No. 2 Hypoid Generator. All three are automatic machines for jobbing or high-speed production and will improve quality besides increasing production.

For the ultimate in durability and accuracy, hardened fine pitch bevel gears are ground in the No. 105 Straight Bevel Coniflex Grinder or the No. 7 Hypoid Grinder. These Grinders are completely automatic wet-type, high-speed machines.

In gear manufacturing, testing is just as important as the actual gear cutting or grinding. One Gleason Tester—the No. 104 Hypoid Tester—checks the running qualities, tooth spacing and concentricity of gears up to 4¼″ diameter.

An important new feature of the No. 104 is the provision for recording the rolling test on paper, giving a permanent record of tooth to tooth composite error. An electronic pickup head for a recorder is furnished, and the recorder itself may be engaged or disengaged, as required.

Engineering services available

Cutter sharpeners and complete tooling are available to suit your requirements. In addition, the services of the Gleason Engineering Department are at your disposal, at no obligation to determine the best fine pitch gears for your application and the machinery required to produce them. Write for further information.

GLEASON WORKS

Builders of bevel gear machinery for over 90 years

1000 UNIVERSITY AVE., ROCHESTER 3, N.Y.



I've been making tools for wire and ribbon metal forms long enough to know that A. H. Nilson Fourslides are the most adaptable and produce parts most economically. For easy set-up and tool adjustment, accurate feed, and rugged design . . . Nilson Fourslides are my choice.

Look at the part shown on the left . . . made in our Nilson #S-O Fourslide. Better than 5,000 of these are produced per hour *automatically* from coiled stock using .039 dia. tin-plated copper wire, and this tops any previous production method.

I'd suggest you contact Nilson yourself and learn how you can increase production and lower costs with Nilson automatic Fourslides.



Actual Size

A.H. NILSON MACHINE COMPANY

1525 RAILROAD AVENUE, BRIDGEPORT 5, CONNECTICUT

Automatic Chain Making Machines : Staple Forming Machines : Wire and Stock Reels : Wire Straightening Equipment
Side Feeds for Presses : Wire & Ribbon Stock Forming Machines

being manifested to hold off for a change in the market. Improvements in some instances have been deferred. In other cases, contemplated enlargements have been reduced or estimates cut down. Notwithstanding, as already observed, the builders have all they can do, with engagements in several instances for months ahead. The Pennsylvania Railroad shops are said at the present moment to have some 90 engines in various stages of construction, and all other leading lines of transportation are constantly adding to their equipment.

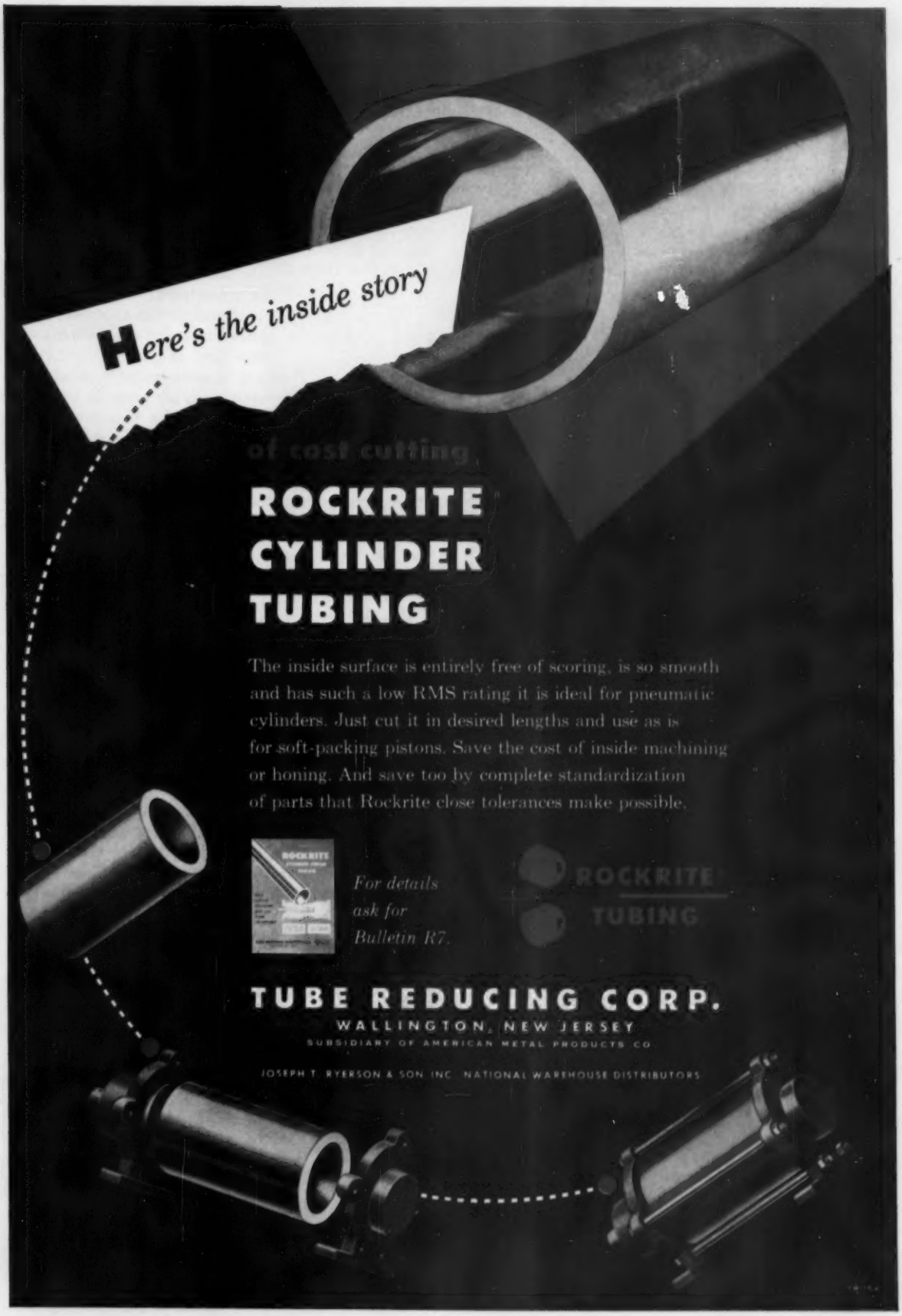
Apr. 1, 1880

Proposes Air Ship To Cross Atlantic

Elsewhere in the present issue of THE IRON AGE we have given accounts which we believe are reliable of men walking *on* the water, and sailing *under* it. Here is a statement detailed and circumstantial, with all the appearance of truth, of a man who has made all his arrangements to go from New York to London, thro' the air, next month. We do not know the authority upon which this story rests, but we suppose its success is quite possible:

"An aerial ship, called the City of New York, intended for a trans Atlantic voyage, has been in the course of construction for some months past, in the vicinity of this city, and is now so nearly completed that she will be ready to undertake the trip in October. The aeronaut who has charge of the enterprise is Mr. Lowe, of New Hampshire, who has made several successful assensions. The dimensions of the ship are greater than those of any balloon previously built. The capacity of the gas receiver is 725,000 cubic feet; the aggregate hight of the balloon from the valve to the bottom of the boat is upward of 300 feet, and the diameter 130 feet.

"Mr. Lowe proposes to go directly from New York to London


Here's the inside story
of cost cutting
ROCKRITE
CYLINDER
TUBING
The inside surface is entirely free of scoring, is so smooth and has such a low RMS rating it is ideal for pneumatic cylinders. Just cut it in desired lengths and use as is for soft-packing pistons. Save the cost of inside machining or honing. And save too by complete standardization of parts that Rockrite close tolerances make possible.
ROCKRITE
For details ask for Bulletin R7.
ROCKRITE
TUBING
TUBE REDUCING CORP.
WALLINGTON, NEW JERSEY
SUBSIDIARY OF AMERICAN METAL PRODUCTS CO
JOSEPH T. RYERSON & SON, INC. NATIONAL WAREHOUSE DISTRIBUTORS

in from 48 to 63 hours. Dropping below the basket is a metalic life-boat, in which is placed an Erricson engine. Its particular purpose is the control of a propeller, rigged upon the principle of the screw, by which it is proposed to obtain a regulating power. The propeller is fixed in the bow of the life-boat, projecting at an angle of about 45 degrees. From a wheel at the extremity, twenty fans radiate; each of these fans is five feet in length, widening gradually from the point of contact with the screw to the extremity, where the width of each is one and a half feet.

"Mr. Lowe claims that by the application of these mechanical contrivances, his air-ship can be readily raised or lowered to seek different currents of air; that they will give him ample steerage way, and that they will prevent the rotary motion of the machine."

September 1859

Zirconium Use Grows

A little more than two years ago the attention of steel makers and metallurgists was arrested by published results of experiments with zirconium in steel. The claims were in some respects sensational, particularly as regards the effect on sulphur and phosphorus. The use of zirconium in steel making has increased measurably and with quite satisfactory results. Recent statistics afford one measure of the growth of this use. Brazil is the source of most of the zirconium ores used in the United States. The domestic output is small. Whereas in 1919 imports were 11,023 pounds, for 1924 they were reported at 619,220 pounds.

Sept. 3, 1925

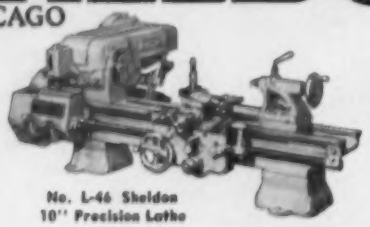
Trade With Zanzibar

American commerce with Zanzibar is steadily growing, that being a central point on the Eastern coast of Africa for the destination of commodities. Trade is largely in control of natives of British India. The population of the island, which is about 50 miles in extreme length, surrounded by coral reefs, number 300,000, including Arabs, and negroes in a state of servitude. Exports are chiefly made up of cloves, ivory, gum, coal, &c. A recent letter from Zanzibar says a single invoice of cloves taken by an English steamer, was valued at $250,000. There are several American firms who ship spices, gums, hides, &c., to the United States to the value of a few hundred thousand dollars per annum, in exchange for cotton and oil. Of late it is observed that the export of cotton cloths to Zanzibar is becom-

Turn to page E-46

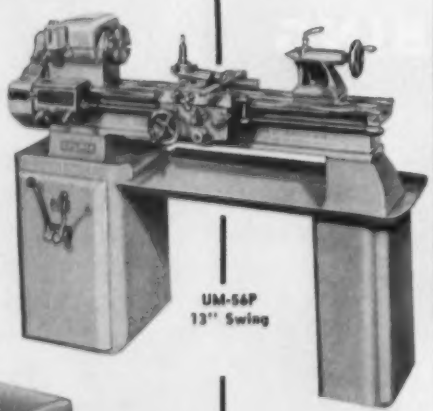
SHELDON

CHICAGO U. S. A.

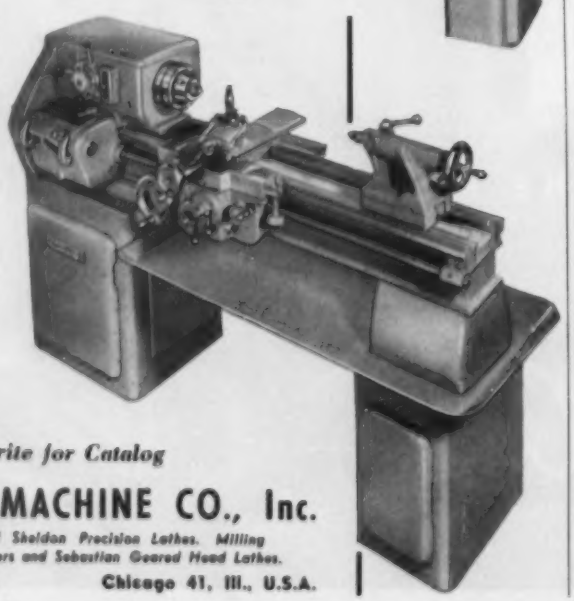


No. L-46 Sheldon
10" Precision Lathe

Strong and rigid thru advanced engineering, these modern, faster, easier-to-operate, precision lathes will do the bulk of every-day tool room and machine shop work. They have "zero precision" tapered roller bearings . . . pass 19 tolerance checks to assure accuracy. They have extra collet capacity for size; full quick change gears; double walled aprons; large motors and efficient drives; etc., etc. They save floor space and reduce power costs. Built in a special machine tool plant by modern methods, they are moderate in price and profitable in use.



UM-56P
13" Swing



13" and 15" Sebastian
Geared Head Lathes
(Built by Sheldon)

Write for Catalog

SHELDON MACHINE CO., Inc.

Manufacturers of Sheldon Precision Lathes, Milling Machines and Shapers and Sebastian Geared Head Lathes.

4224 N. Knox Ave. Chicago 41, Ill., U.S.A.

NICHOLSON FILE CO.,

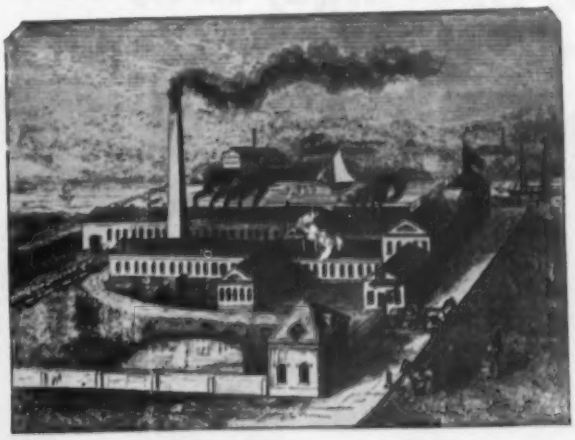
PROVIDENCE, R. I.,

INCORPORATED 1864.

TAPER FILES

And all other kinds below 6 inches

IN BOXES OF ONE DOZEN EACH.



Every File Warranted.

THE NICHOLSON FILE.

All Nicholson Files are cut with the Patent *Increment Cut*, an invention owned and controled exclusively by us, the file cut in this manner being Patented as a new article of manufacture, and differs from all other machine cut files (all of which have their teeth cut with equal spaces) by being cut with teeth slightly *expanding or increasing in size and space from the point*, thus avoiding the too great regularity of teeth common to all other machine cut files. The tendency of all cutting tools with teeth or cutters placed at regular distances from each other may be illustrated (to the machinist at least) by the fluted reamer—as it is well known that if a round reamer be made with (say 12) teeth whose spaces are equidistant, the hole reamed will *not* be round and smooth, but will approximate to a hexagon in shape. Whereas, if the same number of teeth be made of irregular distances, the hole reamed will be both round and smooth. The same is true of a file, hence the necessity of its having teeth at unequal distances, and to which we have applied the name of Increment Cut File, which possesses all the advantages of hand cut work, and the accuracy and uniformityof machine work. It is now upwards of six years since this File was introduced to the public, and the demand has increased until our production is undoubtedly treble that of any File manufactory in the country.

Our prices are as low as it is possible to furnish a really first-class File *from the best of File Steel*, and may be had, with full terms and conditions, by addressing the

NICHOLSON FILE COMPANY,
Providence, R. I.

This was NICHOLSON'S first advertisement in Iron Age, January 16, 1873

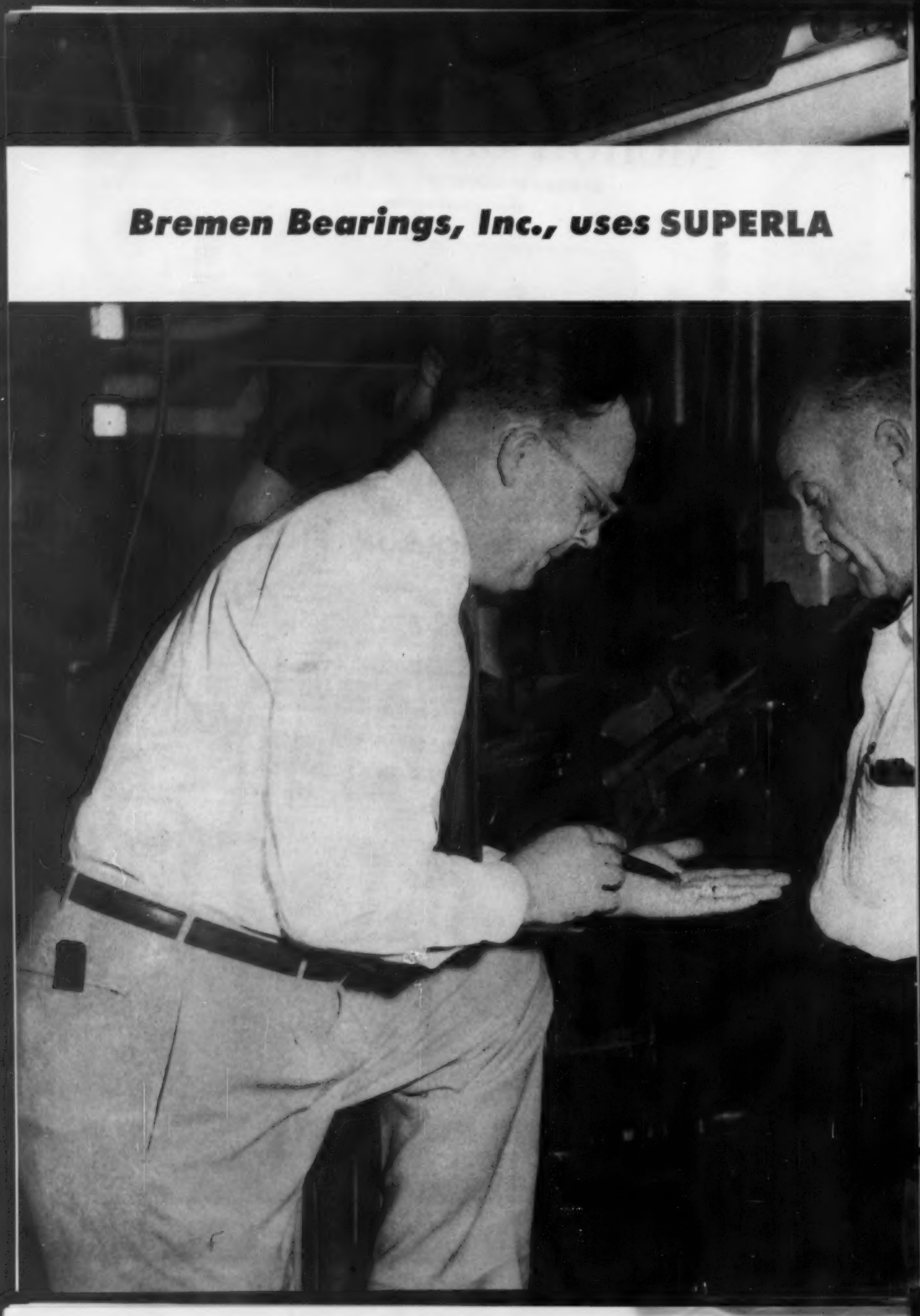
Nicholson has shared—and *Iron Age* has chronicled—the last century's tremendous industrial growth. The factory shown here was the first of several Nicholson plants at Providence; Philadelphia; Anderson, Indiana; Port Hope, Ontario; and Rotterdam, Holland.

"Our production is undoubtedly treble that of any File manufactory in the country," this 1873 ad stated. From that day to this, Nicholson has maintained its leadership. How? By keeping pace with industrial requirements through constant file research and development. And by the steadfast Nicholson policy of *Twelve perfect files in every dozen.*

NICHOLSON U.S.A.

NICHOLSON FILE COMPANY, PROVIDENCE 1, RHODE ISLAND
(In Canada: Nicholson File Company of Canada Ltd., Port Hope, Ontario)

NICHOLSON FILES *Highest quality for 91 years*



Bremen Bearings, Inc., uses SUPERLA



Soluble Oil to give bearings the clean, cool treatment



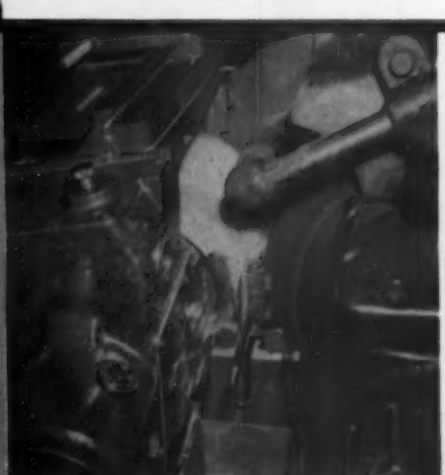
PRECISION NEEDLE BEARINGS are the exclusive product of Bremen Bearings, Inc., Bremen, Indiana. SUPERLA Soluble Oil is used exclusively in all eight of the Company's Cincinnati Centerless Grinders. Plant management experimented with various soluble oils before settling on SUPERLA. They found none could compare with SUPERLA Soluble Oil with respect to wheel loading, stability and tool machine cleanliness.

Plus these benefits, Bremen found SUPERLA mixed readily with water regardless of degree of hardness. The Company found, too, that they got longer tool life and maximum rust protection for work and machines.

You will have the same experience with SUPERLA Soluble Oil. Find out. Inquire of your Standard Oil lubrication specialist. In the Midwest call your nearby Standard Oil office. Or write Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

Franklin D. Clark (right), Sales Manager, Bremen Bearings, Inc., and Standard Oil lubrication specialist E. A. Hunt, inspect needle bearing. Gene Hunt is well qualified to assist industrial plants on lubrication problems. In addition to his three years' experience in industrial lubrication sales work, Gene has an M. E. degree from Purdue and has completed the Standard Oil Sales Engineering School. Customers find this experience and training pay off *for them*.

Bearings being ejected from Cincinnati Centerless Grinder at Bremen Bearings, Inc. The Company manufactures needle and spindle bearings to customers' specifications in sizes from 1/16 to ½ inch with tolerances of .0001" and finishes to 3 micro-inches. SUPERLA Soluble Oil is used on all of Company's grinding machines.



STANDARD

STANDARD OIL COMPANY
(Indiana)

ing a formidable item, two cargoes having gone from Boston only last week, comprising 3290 bales, or 3,047,686 yards, valued at $208,000.

Fleet Polices Coast

A feature at Zanzibar is an English ship anchored near by, serving as a rendezvous for a fleet of steam launches, which act as a sort of police, scouring the surrounding seas and coast of the main land, for the suppression of illegitimate trade and slave traffic. The statement is that these police, subjects of Great Britain, receive $20 a ton for every slave dhow and $25 for every slave which they may capture. Though in a measure self-constituted and liable to abuse, the authority thus exercised is spoken of as a wholesome influence, under which every lawful enterprise can prosper, American merchants are giving more attention to this remote part of the world, with hopeful prospects.

Jan. 8, 1880

Stove Prices Low

After a somewhat careful canvass of the stove trade, we are satisfied that there is less present occasion for the gloomy feeling expressed by a majority of manufacturers than there has been at any time since the panic. Prices are low, and the margin of profit small, but there is a good prospect of a fair fall business, and but little danger that any considerable quantity of desirable goods now in stock will be carried over into next year. Extensive preparations have been made to meet even the limited demand expected, and the activity in the pattern shops shows that there is no present probability, at least, of a return to the plain goods and standard styles of former years. What the trade have learned to regard as "frills," are in as great demand as ever, and, all other things being equal, the stove which has the most "frills" seems to stand best . . .

Sept. 14, 1876

reach !

A NEW PEAK IN BENDING EFFICIENCY

Pedrick Production Benders offer new standards of efficiency and economy for all pipe, tube and structural bending. Even the most difficult bends can now be made on a production or jobbing basis.

Let us know your problem—and supply a cost-cutting solution.

Write PEDRICK TOOL & MACHINE CO., 3640 N. Lawrence St., Philadelphia 40, Pa. Dept. 2.





FREE "PEDRICK LINE" BULLETIN. WRITE TODAY.

PEDRICK production benders

Labor Moves from Farm to Factory

In the decade from 1870 to 1880 there was relatively a much more rapid growth in the manufactures of the United States than in agricultural pursuits. The following statement shows the number of population employed in agriculture on the one hand, and in manufactures, mechanics and mining on the other, in the years 1870 and 1880 respectively:

	Number
Employed in agriculture in 1880	7,670,493
Employed in agriculture in 1870	5,922,471
Increase	1,748,922, or 29.5 pr ct.
Employed in manufactures, mechanics and mining in 1880	3,837,112
Employed in manufactures, mechanics and mining in 1870	2,707,421
Increase	1,129,691, or 41.7 pr ct.

This comparison indicates that the diversion from agricultural to

Turn to page E-50

DISSTON
HAS THE EDGE®

in files

If you want top-quality, long-lasting files—choose Disston. They cut fast, smooth, easy. You'll do better filing with a Disston whether American or Swiss pattern types.

DISSTON BITE-RITE® AMERICAN PATTERN FILES. Sharp teeth cut level and smooth at each stroke, eliminate tracking. This means better finishing, faster work. Exclusive Bite-Rite design forms curls instead of chips, thus assuring clean, open gullets for continued better filing.

DISSTON SUPERFINE® SWISS PATTERN FILES. Acclaimed for their accuracy by tool and die makers and machinists who recognize quality tools. Available in a complete assortment of sizes and cuts for filing intricate shapes . . . also for bench filing requiring bench and parallel machine files.

Write today for complete Disston file information and file selection wall charts for your shop.

HENRY DISSTON & SONS, INC.

619 Tacony, Philadelphia 35, Pa.

Other factories and branches: Toronto, Ont.; Seattle, Wash.; Chicago, Ill.

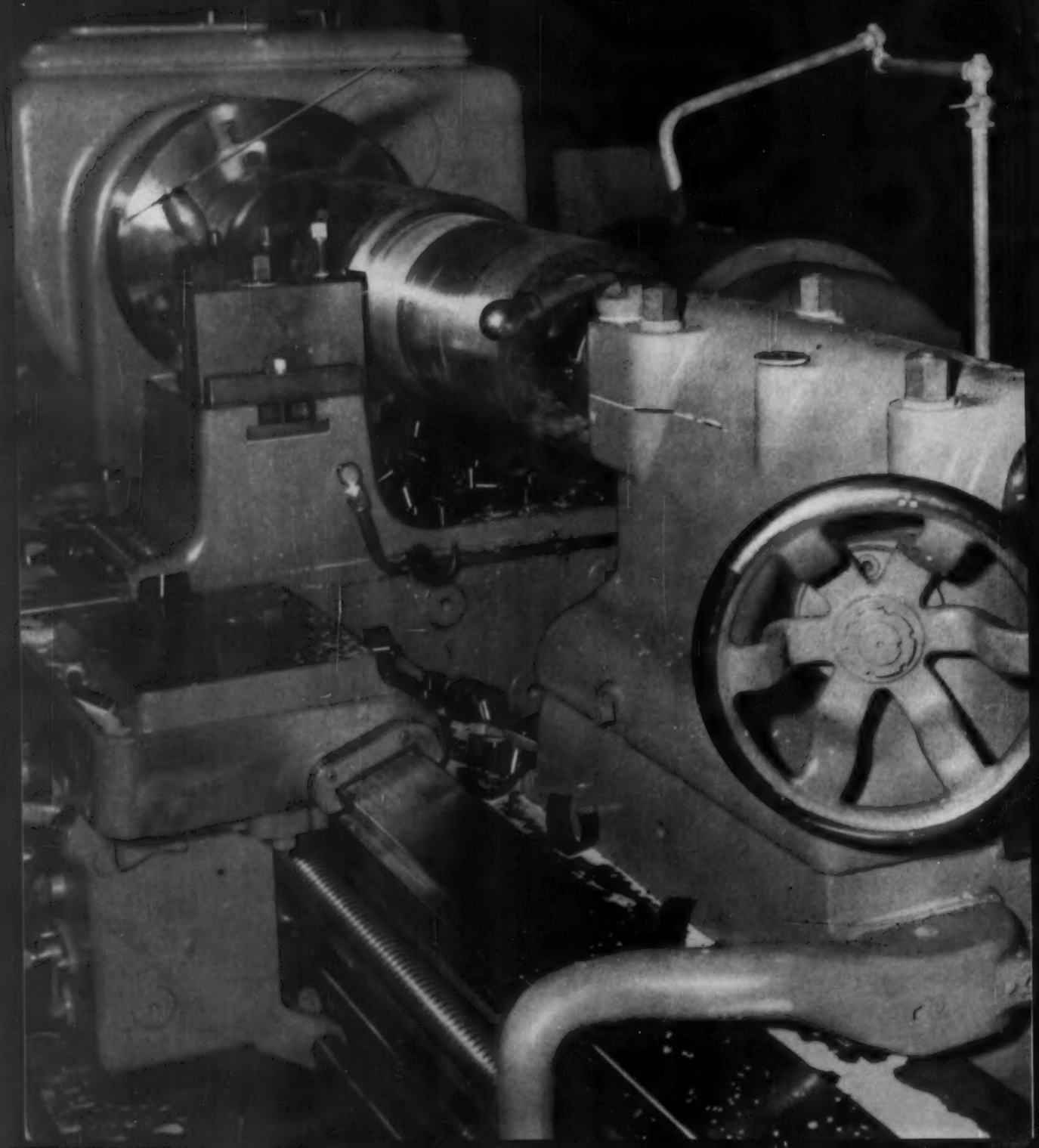


1855-1955

DISSTON HAS HELD THE EDGE IN METAL CUTTING FOR 100 YEARS

Since 1855, when Disston cast the first crucible saw steel in America, the company has been a recognized leader in the metal-cutting industry. Disston began the manufacture of high-quality files in 1865—and during the century, has set the pace in metal cutting with such tools as circular saws, band saws, exceptionally fine hack saw blades. From the manufacture of these saws to the production of stainless steel and alloy steel shapes, Disston has maintained its leadership. Today, Disston is observing its 100th anniversary of fine steel making—and a long association with the metal-cutting industry.

How a 32" LeBlond



takes a measured 118-HP cut

Wanted. *A 32″ lathe to stand up under 100-plus horsepower cuts. Must also provide unusually-wide range of feeds and infinitely-variable speeds.*

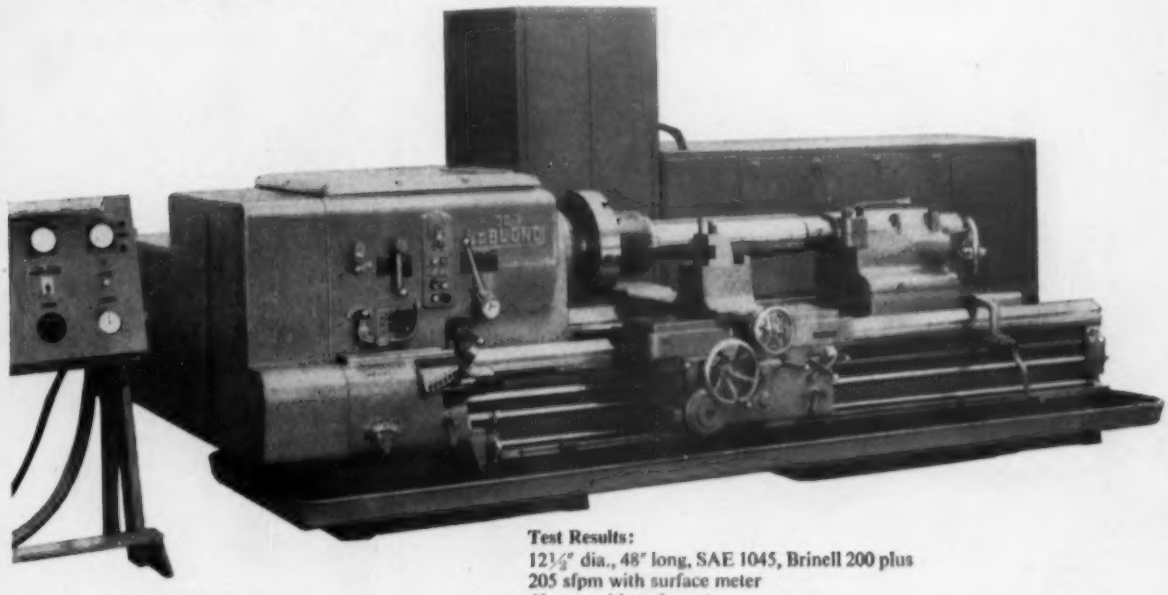
No standard model could fill these requirements. But our new 32″ Heavy Duty had the ruggedness that was needed. We made some changes, mainly in the headstock, and produced a 32″ lathe with these specifications:

Drive; 125 hp, variable speed.

Speeds; infinite from 42 to 1400 rpm.

Feeds; 56 from .002 to .250 ipr.

Plus these features that are standard on our 25″ and 32″ lathes: 4-directional power rapid traverse built into apron; one-piece double-wall apron, hardened rack; totally-enclosed quick-change box; hardened and ground replaceable steel bed ways; thrust-lock tailstock.



Test Results:
12¼″ dia., 48″ long, SAE 1045, Brinell 200 plus
205 sfpm with surface meter
63 rpm with tachometer
.083″ feed per rev.
1″ depth of cut
2 hp reading on meter before cut
120 hp reading on meter during cut
118 net hp at the cut

This lathe, with variations to suit your needs, is now available. It appears to be well-suited to very high production turning of large forged or cast-steel shafts and rolls. For quotations against your specifications, get in touch with the nearest LeBlond Distributor or write Cincinnati direct.

. . . . cut with confidence

LeBLOND *of Cincinnati*

THE R. K. LEBLOND MACHINE TOOL COMPANY, CINCINNATI 8, OHIO

WORLD'S LARGEST BUILDER OF A COMPLETE LINE OF LATHES • *FOR MORE THAN 67 YEARS.*



This Book Tells You

THE QUICK AND EASY WAY TO HAND CUT METALS

such as ¾" bolts
¾" wire rope
¾" chain
1½ x 9/32 flat bars
steel strapping, insulated cable, hard wire, etc.

Makes actual time test comparisons and shows you how to hand cut with a portable tool the above and many other sizes and types of soft and hard metals.

® HKP

WRITE FOR THIS *TELLS-HOW* BOOK TODAY!

H. K. PORTER, INC.
Somerville 43, Mass.

Please send me my free copy of "Cutting Metal the Easy Way".

NAME _____

COMPANY _____

STREET _____

CITY _____ STATE _____

MY DISTRIBUTOR IS _____

manufacturing employments was probably in active operation during the years from 1870 to 1880, for it will be seen that in agriculture the increase in the number employed was only 29.5 per cent., while in manufactures the gain was at the rate of 41.7 per cent. Showing the same tendency, the value of farms increased during the decade only 10 per cent., while the value of manufactured products increased 27½ per cent.

Jan. 1, 1885

Early Fire Fighters Had Their Troubles

In a description of a conflagration at the Meriden-Britannia Works, the difficulties of industrial fire fighting in early days is graphically set forth. This account says:

"One of the water mains was shut, by mistake. At least fifteen or twenty minutes of valuable time was lost in confusion. On the arrival of the Charter Oak Company, they took a double hydrant directly in front of the fire and forgot to attach their hose. Washington Engine Company came up and attached to the same hydrant, which was the cause of many hard words and loss of more time. The hose boys were inexperienced and in stretching their hose they pulled off one or two lengths, which was just enough not to reach the fire. While these matters and the incidental confusion were progressing, the fire gained an almost unobstructed advantage. The powerful steam pump of the company was started in good season, but the water being very low, the supply was entirely inadequate. The falling slate from the roof rendered it almost impossible to ascend the ladders and the combination of the above incidents, deficiencies and faults was sufficient to cause an almost hopeless confusion."

July 21, 1870

Another **PRODUCTION SOLUTION**
by
MOTCH & MERRYWEATHER

Does the Job Best!

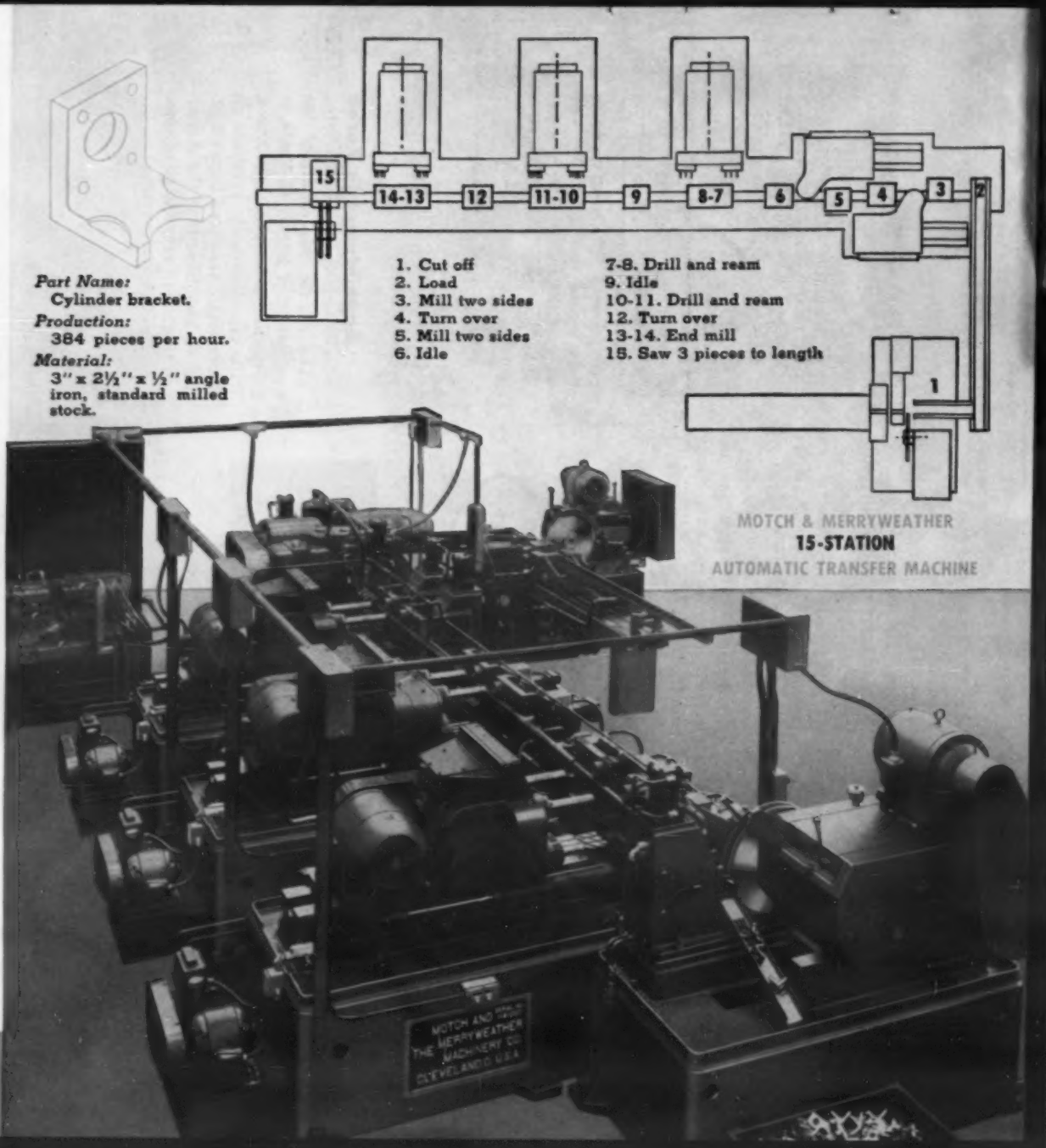
A variety of machining operations, unique in sequence, is combined on a new 15-station automatic transfer machine. Grouping standard machine tool units attains maximum production and utilizes automation. In addition, the M. & M. Triple-Chip circular saw cut-off makes possible the use of low cost stock material; increases your ultimate savings. Start by sending us your part drawings for a production solution by Motch & Merryweather.

THE MOTCH & MERRYWEATHER MACHINERY CO.

MACHINERY MANUFACTURING DIVISION

CLEVELAND 13, OHIO

Builders of Circular Sawing Equipment, Production Milling, Automatic and Special Machines



Business Wanted In Parnassus, Pa.

The improvement in business promises to give life to a great many latent industrial enterprises and lead to the establishment of others, especially in small towns in the West. Many of these towns, realizing the advantage of the establishment of manufactories among them, are holding out liberal inducements to those who will locate in their midst. We have before us the circular of the Parnassus (Pa.) Industrial Association. Parnassus is a little town on the line of the Allegheny Valley Railroad and on the Allegheny River, 17 miles from Pittsburgh, and just over the Allegheny County line. It is in the midst of a good coal field, and with natural gas wells, both north and south. This association offers a liberal donation of land lying between the railroad and the river, with a river frontage, together with a liberal donation in cash, to any manufacturing establishment that will locate in Parnassus. The town is free from debt and taxation light. The facilities for transportation are very good; arrangements for low freight can be made, and the offer is a liberal one. The association prefers the establishment of several small works to one large one. Any one seeking a location for manufacturing purposes may find the inducements . . . worth considering.

Mar. 4, 1880

For precision with speed

specify

GRAND RAPIDS GRINDERS



No. 55 Grand Rapids Hydraulic Feed Surface Grinder. Working surface of table 12" x 36". Longitudinal table speed 125 fpm. No. 55 Grand Rapids Grinder has *proven performance*. Sixty percent of all Grand Rapids Hydraulic Feed Surface Grinders are sold to customers already using Gallmeyer & Livingston grinding machinery. Write for Bulletin GL 103-54.

Grand Rapids No. 62 and 60 Motor Drive Universal Cutter and Tool Grinders are built to meet the needs of manufacturers requiring modern machines providing maximum convenience of operation in the sharpening of milling cutters, gear cutters, reamers and similar tools. Ask for Bulletin GL 2-53.

GALLMEYER & LIVINGSTON

Grand Rapids 2, Mich.

Appointment In Korea

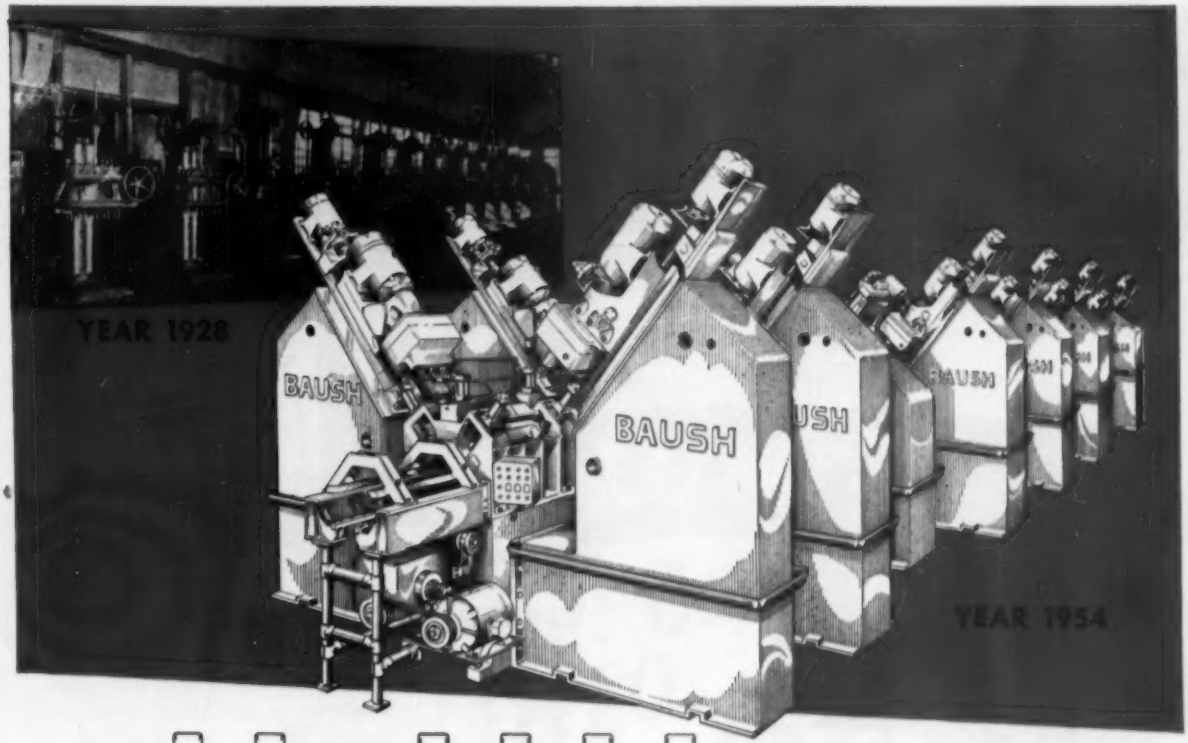
The Senate has confirmed the nomination of Lucius H. Foote, of California, to be Minister to Korea. With our diplomatic relations in Korea established on a better footing we may hope that the American treaty will prove to be of some practical value.

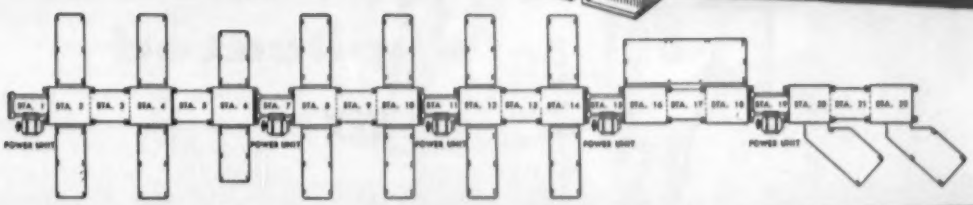
Feb. 5, 1885

Automatic Fire-alarm

An automatic fire-alarm of simple construction, known as Judson's automatic fire-alarm, has recently been brought out, the essential feature of which is a wire soldered together at frequent intervals by a very fusible alloy, the melting of which parts the wire and sets off the alarm. The alarm consists of a clock mechanism mounted in a suitable manner on a board 4 x 6 inches in size. From this alarm a wire ascends to the ceiling and thence passes over pulleys through the various rooms, closets and apartments in which a fire is liable to occur. The clockwork is kept from unwinding by a

Turn to page E-55





EXCLUSIVE BAUSH TRANSFER FEATURES:
Either mechanical or hydraulic

1. Individuality of each machine.
2. Accurate leveling of one machine to another not important.
3. Each machine has individual electrical panel. Simple as way-type machine.
4. One or more machines can be added to line if more operations are desired.
5. Line can be broken and automatic loader, checking, or roll-over fixtures added.
6. Give maximum production with minimum maintenance.
7. Readily adapted to automation.

BAUSH
MACHINE TOOL CO.
SPRINGFIELD 7, MASSACHUSETTS

BAUSH

TRANSFER MACHINE

completes 12,600 operations per hour to

MINIMIZE **. . . Labor Costs**

MAXIMIZE **. . . Production**

This 22-station automatic transfer — designed for specific operations on a new V-8 engine — is another example of Baush ingenuity and "know-how" in machine tool construction.

Transfer consists of 22 stations with 5 complete machine sections with 14 Model "S" Leadscrew Units and 2 Hydraulic Units.

There are five 4-position Transfer Sections with arch fixtures and bushing plates — 2 checking fixtures — power units for transfer — hydraulic locating and clamping of part and 16 Fixed Center Ball Bearing Heads having a total of 105 spindles to complete 12,600 operations to drill, core-drill, chamfer and ream 120 cylinder blocks per hour.





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...and REX is the original high speed steel by which all others are judged

Great works of art clearly show the unique skills of their maker. Even the most careful copy can never truly duplicate the original.

Crucible REX® High Speed Steels are *originals*, too. Ever since 1900, when the Country's leading tool steel specialists combined their knowledge and formed Crucible, we have lavished on tool steel making all the skill and care that goes into any work of art.

That's why REX is the standard of comparison wherever high speed steels are used. But see for yourself. Put REX to work in your shop . . . check its hardenability, response to heat treatment, general quality and fine tool performance. We feel sure that, like thousands of others, you'll come back for more.

CRUCIBLE first name in special purpose steels

54 years of Fine steelmaking **TOOL STEELS**

CRUCIBLE STEEL COMPANY OF AMERICA · TOOL STEEL SALES · SYRACUSE, N. Y.

click, to which a lever-arm is attached extending beyond the casing; to the end of this lever, at the side of the alarm, is fastened a spiral spring, which, when distended, holds the lever in place. The spring is kept in a state of tension by the wire, which passes through the building and is securely fastened at its further end.

Feb. 5, 1885

Wide Circulation

THE IRON AGE circulates in almost every state in the Union; is read by Hardware Men and Iron Merchants in nearly every important town; is known to be the medium of intercourse between the trade, and any advertisement appearing in its columns is certain to attract attention in the desired quarter. We commend these facts to the consideration of any Manufacturer, who has any announcement he desires to make to the Hardware Trade in any section of the United States, or Canada. Money expended in advertising in THE IRON AGE is sure to pay.

Oct. 15, 1860

Pennsy Plans Bonus For Engineers—1868

We give below the substance of orders issued a short time ago to the engineers and firemen of the Pennsylvania Railroad:

"At close of the year a calculation will be made of the amount of coal, tallow, oil, etc., used in running locomotives and the amount saved as compared with last year ascertained, and the money saved will be equally divided between the company, engineers and firemen.

Performance Posted

Printed monthly statements showing the performance of each locomotive, and giving the names of the engineer and fireman will be posted up in the engine houses. The consumption of fuel and stores in the motive department of the road last year was very great, and it is thought by paying attention to the above orders a considerable saving can be effected for the company, and the men at the end of each year secure for themselves a handsome bonus."

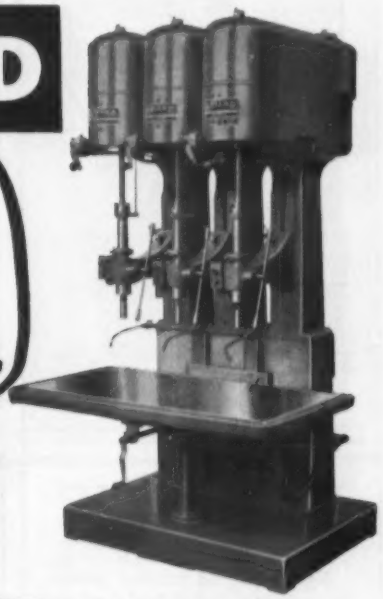
May 28, 1868

Stirs Comment

The interview with Secretary Manning published in THE IRON AGE, and setting forth the position of the Administration on the tariff, has led to considerable correspondence between the Administration and its friends and opponents on this subject. There is no doubt that when the time for action shall have

EDLUND

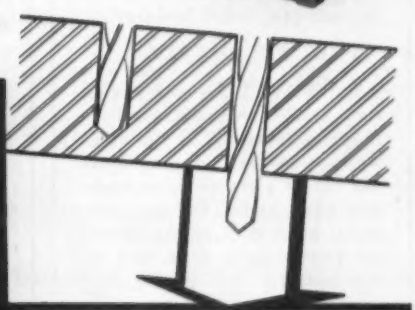
Cuts Cost $1280.... On One Job.*



An EDLUND 2F Variable Speed Drilling and Tapping Machine Makes the difference

The Edlund 2F instant change variable speed feature lets you find correct drilling speed under practical on-the-job conditions. Saves valuable production time. No gear or belt changes necessary. Increases tool life by using correct drilling speed for each job requirement.

Standard or Special Models, 1 to 8 Spindles. 8", 12" or 15" overhang — capacity to 1¼". Available with Power Feed, Reversing Motor Tapper, Lead Screw Tapper, and Back Gears.



The job . . . drilling 7/16" hole 1½" deep in X1020 steel. The Edlund Variable Speed machine drilled 135 pieces per hour compared with 108 pieces per hour for standard machine production. The 25% increase in production reduced costs $1280.*

Write for Bulletin #140, a colorful, illustrated booklet describing the Edlund 2F. Specifications and quotations prepared promptly on request . . . with no obligation on your part.

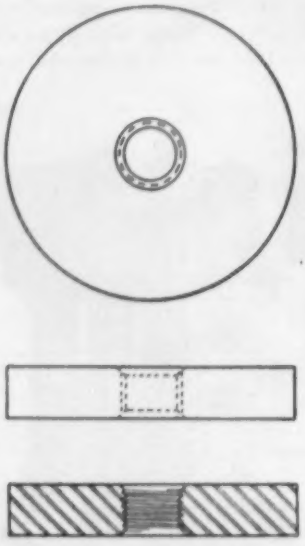
*Case history folder #SF on request.

EDLUND MACHINERY COMPANY

Cortland, New York Division of Bradley Edlund Corp. Affiliated with Precision Castings Co., Inc.

Edlund Representatives in Major Cities

SKILTON
Circular Form Tool



BLANKS

Ever hear of hidden profits in your tool steel inventories?

THEY'RE THERE!

Let SKILTON carry your tool steel inventories and do the machining up to the stage where you take over to make the actual circular form tools. Buy from SKILTON the exact dollar amount of blanks needed for your circular form tool requirements.

Eliminate costly tool steel inventories. Stock SKILTON blanks, ready for forming.

Did you know that for less than one dollar you can purchase one blank for a #00 B. & S.? By buying SKILTON progressive concerns are today recording profits.

Write for complete price and data bulletin.

T. S. SKILTON & SONS
WINSTED CONN.

been reached there will be much spirited controversy. The friends of Messrs. Carlisle and Morrison are anxious to have the Administration keep out of the contest, and let them take charge of the matter and settle the policy of the party among its Members in Congress.

Apr. 9, 1885

Increased Use of Telephones Noted

The report of the directors of the American Bell Telephone Company, read at the annual meeting of the stockholders, presents some interesting facts. Though the telephone business has shared the general dullness of trade, the increase in the number of subscribers and the telephones in use has continued, though at a diminished rate. The following comparative statement gives the statistics for the year, which are substantially correct:

	1883	1884	1885
Exchanges	725	906	764
Branch offices	345	419	481
Miles of wire on poles	....	....	88,481
Miles of wire on buildings	....	....	11,886
Miles of wire underground	....	....	1,225
Total miles of wire	68,571	85,896	101,592
Total circuits	74,484	97,422	107,268
Total subscribers	97,728	123,625	134,601
Total employees	3,716	4,762	5,162

Apr. 9, 1885

Optimism In Adversity

Business continues generally dull, and we cannot hope for much improvement at present. Manufacturers are now exceedingly dull, merchants are very idle, consequently employment is greatly curtailed and workingmen are feeling the pinch severely. We can, of course, expect no speedy relief from congressional action and must therefore expect a period of depression; still we have no fear of a "panic" or a "crisis" or a general "bursting up." Thanks to the sound and healthful cash system the country is generally solvent. Here in New York among the drygoods houses and perhaps the tea importers and one or two other interests, there may be failures, but the condition of the country is safe and healthy, although depressed.

Dec. 12, 1867

Saddlery Hardware

Prominent among Newark, N. J., industries is the manufacture of saddlery hardware. Nearly 20 per cent. of all manufactures in this branch in the United States are located here. In ordinary times employment is given to about 700 workingmen. During the year 1875



Bettmann Archive

SHAFTS, WHEELS and belts lined the shops of yesterday, as in this woodcut. Steam, the basic power source, soon yielded to electricity.

their number was reduced to less than 500, and but few of these were employed on full time. Productions fell off about 25 per cent., while the average decline in prices during the year was about 20 per cent. In the cheaper grades of saddlery hardware, Newark was undersold by other localities, mainly such as employed convict labor, and as a result prices were forced down, and some of the trade in this line was lost to the city; but in all the better and finer qualities of production, which require a high degree of mechanical skill, Newark stands far ahead of any other city in the Union; and in this line of goods the percentage of sales did not vary much from that of 1874.

July 13, 1876

Rain Making

Gen. Daniel Ruggles, of Virginia, at the request of the Senate Committee on Agriculture, appeared before them a few days ago and briefly explained his method of precipitating rainfalls by scientific means. His method (for which he has recently been granted a patent) is to send up to the cloud realm cartridges of dynamite or similar explosive materials in skeleton balloons, and to explode them, either by time fuses or by magneto-electricity, through light metal wire connecting the balloons with the earth. Gen. Ruggles, as the result of many years of study and investigation of this subject, claims that the diffused mists passing over regions or localities suffering from unusual drought may readily be consoliated into rainfalls by concussions and vibrations thus artificially produced, and he has, therefore, suggested to the committee that Congress might provide a small appropriation for expenditure by the Commissioner of Agriculture, to test the practicability of aiding the agricultural interests of the country in this manner. The committee listened to

THOMAS PROSSER & SON

Founded 1845

Serving Metalworking for 110 years

Now offers

A NEW CARBIDE GRINDER

Grind Carbide Tools Better at Lower Cost

1. **Saves Diamond Wheels!** Copious flow of water keeps the wheels clean, and reduces loading and grooving.
2. **Saves Carbide Tools!** Wet grinding overcomes heat checks and cracking.
3. **Grinds Faster!** More metal can be removed in a given time with proper wet grinding. (Either diamond or silicon carbide wheels.)
4. **Produces Better Cutting Edges!** Sharp wheels grind sharp tools. Wet grinding keeps wheels clean and sharp.
5. **Moderate Price!** Suitable for the average plant.



Model AW

Write for full details

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Everyone recognized this in days gone by as the sign of a cigar store...

Today smart gear users recognize this CINTI is the sign of *good* gears made to *your* specifications.

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THE CINCINNATI GEAR CO. • CINCINNATI 27, OHIO

Gen. Ruggles' statements with much interest, and requested him to prepare an amplified memorial on the subject with a view to their taking it more fully into consideration at an early day.

Feb. 19, 1880

Worcester Explosion

A terrific explosion occurred in the factory of Messrs. I. Washburn & Co., on the 22nd ult. at Worcester, Mass., of which the Spy gives account: "One of the most terrible explosions that ever occurred in this vicinity, took place in this city yesterday afternoon, about half-past one o'clock, at the wire factory of Messrs. I. Washburn & Co., on Grove St.

The large steam boiler, 30 feet long and 4 feet in diameter, and weighing about 5 tons, attached to their powerful engine, exploded with tremendous force, shattering the engine house (which is of brick) into atoms, demolishing a portion of the walls of the main building adjacent, and injuring several workmen, one severely, but it is hoped not fatally."

We are pleased to be able to say that the damage resulting from this accident was promptly repaired, and that the establishment is again in full working order.—*Ed.*

September 1859



Bettmann Archive

CUTTING screw threads with a hand chaser. From an 1875 engraving.

On Mental Labor

The injurious effects of mental labor are, in a great measure, owing to extensive forcing in early youth; to sudden or misdirected study; to the co-operation of depressing emotions or passions; to the neglect of the ordinary rules of hygiene; to the neglect of the hints of the body; or to the presence of the seeds of disease, degeneration, and decay in the system. The man of healthy phlegmetic or choleric temperament is less likely to be injured by application, than one of sanguine or melancholic type; yet these latter, with allowance for the original constitution, may be capable of vast efforts.

Fear not to do manfully work for which your gifts qualify you, but do it as one who must give an account of both soul and body. Work, and work hard while it is day; the night cometh soon enough —do not hasten it.

April, 1859

SLASH WIRE AND BAR STOCK INVENTORY COSTS
with this combination



LEWIS NO. 11-F TRAVEL-CUT, 3/4" CAPACITY

No need to build up big stocks of hundreds of different wire or bar stock lengths when you use LEWIS machines in your plant. LEWIS machines handle practically all materials and shapes from .012" to ¾" . . . quickly and economically produce the length of wire or bar stock you need . . . when you need it, as you need it. For more than 48 years, sturdy, dependable LEWIS machines have made possible substantial savings for leading manufacturers in the metal-working industry.

Descriptive literature on the COMPLETE Lewis line of 23 machines for straightening and cutting wire and/or bar stock from .012" to ¾" available on request.

THE LEWIS MACHINE CO.

3443 EAST 76th STREET CLEVELAND 27, OHIO



EXTRA VALUE..FROM GASOLINE TO SUN'S METALWORKING OILS

Sun Oil Company makes over 400 petroleum products ...refines better value into every one of them

Sun puts the same extra value into its metalworking oils that it puts into famous Blue Sunoco—Premium Performance at Regular Price.

EXAMPLE: About ten years ago Sun became aware of a hidden source of trouble in metalworking... inadequate lubrication of the ways which support the tables or carriages during a machining operation. The costly result of this inadequate lubrication is called "stick-slip" or jumpy table. This stick... slip...stick (or jump) is often less than a thousandth of an inch...hard to detect and yet enough to cause poor finish, rejects, reduced tool life and a fall-off in production.

SOLUTION: Sun developed its now famous Sunoco Way Lubricant—a product so outstanding in its ability to overcome "stick-slip" that today, more than ten years later, it still is the standard of the metalworking industry.

RESULT: The extra value of Sunoco Way Lubricant has been proved so conclusively that it is approved by more than 55 of the country's leading machine tool manufacturers.

For EXTRA VALUE in petroleum products... buy Sun!

Please turn to the next page

SUNOCO

INDUSTRIAL PRODUCTS DEPARTMENT

SUN OIL COMPANY PHILADELPHIA 3, PA.

IN CANADA: SUN OIL COMPANY LTD., TORONTO AND MONTREAL



GREATER COOLING POWER—better finishes...tools last longer...production costs reduced.



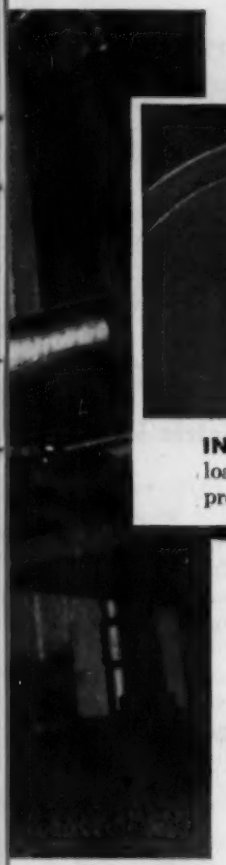
WIDER APPLICATIONS—tops for rolling...hot and cold washing...and rust-proofing, too!



INCREASED DETERGENCY—prevents loading and glazing of grinding wheels, prolongs wheel life.



NEW S.E.C.O.—pours and mixes easily... has better operator acceptance... keeps parts and machines cleaner.





Industry's most widely used soluble cutting oil continues to give highest machining efficiency

OVER 100 MILLION GALLONS OF S.E.C.O. EMULSIONS USED IN '54

The reasons? Simple.
Primarily, industry has faith in Sunoco Emulsifying Cutting Oil. Its high machining efficiency has proven itself over a period of years. S.E.C.O. is the original 100% petroleum emulsifying cutting oil. 'Way back in 1916, machinists started using S.E.C.O.

Constantly improving in quality over the years, S.E.C.O. is now better than ever. During 1954 new refining facilities once more improved industry's most widely used cutting oil... gave users even higher machining efficiency ...better finishes... longer tool life... increased production.

Test the new S.E.C.O. in your own plant. Notice how its high detergency and purity keeps tools, parts and machines clean... how easily it mixes in hot, cold or hard water. Notice, too, how S.E.C.O. cuts operating costs... improves rolling operations, hot and cold washing, and rustproofing.

See for yourself why Sun's S.E.C.O. continues to be the leading emulsifying cutting oil in the country today. For information, call your nearest Sun office or write SUN OIL COMPANY, Philadelphia 3, Pa., Dept. IA-6.

SUNOCO

INDUSTRIAL PRODUCTS DEPARTMENT

SUN OIL COMPANY

PHILADELPHIA 3, PA.

IN CANADA: SUN OIL COMPANY LTD., TORONTO AND MONTREAL



Bettmann Archive

POWER LOSS was a big factor in the belt, wheel and shaft era of machine shop operations. Above: Typical 19th century shop.

Has Long Run

During the last year, ending May 1st, Ashland Furnace, using the Ashland smelting coal, was in blast 311¼ days, stopping twelve hours on each Sunday. In that blast she made 12,620 tons of excellent iron, an average of about 40½ tons daily, on a hearth of Mt. Savage fire brick, which is now in its third year, and yet in excellent condition, something rather out the usual order. The smoke stack at the furnace, ninety feet high, which had been in an insecure condition for some time, fell on Sunday night the 11th, but without serious damage. It was to have been taken down next day.

June 5, 1873



Bettmann Archive

MAKING FILES in the 1800's was a slow and tedious business. Each raised portion was the result of painstaking hand and hammer work.

An Ignoble Ending

The Great Eastern Steamship Company, of England, have been ordered by the court to wind up their affairs—an ignoble ending for a scheme so ambitious.

Mar. 12, 1885

Electric Light

The contract for a 10,000-candle-power electric light, to be placed in the dome of the County Court House at Wabash, Ind., intended to light that city, has been let to the Brush Electric Light Company, of Cleveland, Ohio, for $1800. The agreement states that, should the light prove unsatisfactory, the city shall be at no expense. A guarantee for a perfect light has been given by the company.

Feb. 12 1880

Came The Reckoning

The game of baseball between the nines of the Russell & Erwin and Hart Manufacturing Company last Saturday resulted according to the decision of the umpire in a victory for R. & E. by a score of 40 to 35. The Hart nine, however, takes exception to the rulings of the umpire and have referred the issue at question to "acknowledged authority." If the umpire was wrong, they won the game by four runs.

July 13, 1871

Patent Law Models

Models must not exceed 12 inches in any of their dimensions. Inventors must be very careful to observe it, as the P. O. is sure to refuse them unless they conform to the rule.

June 18, 1856

Production Pointers from GISHOLT

GISHOLT TIME-SAVING IDEAS



Presented as a service to production men, we hope some of these interesting ideas, chosen from thousands of jobs, will suggest ways to help cut time and costs in your own work.

MASSIVE FLYWHEELS COMPLETED IN ONE AUTOMATIC OPERATION

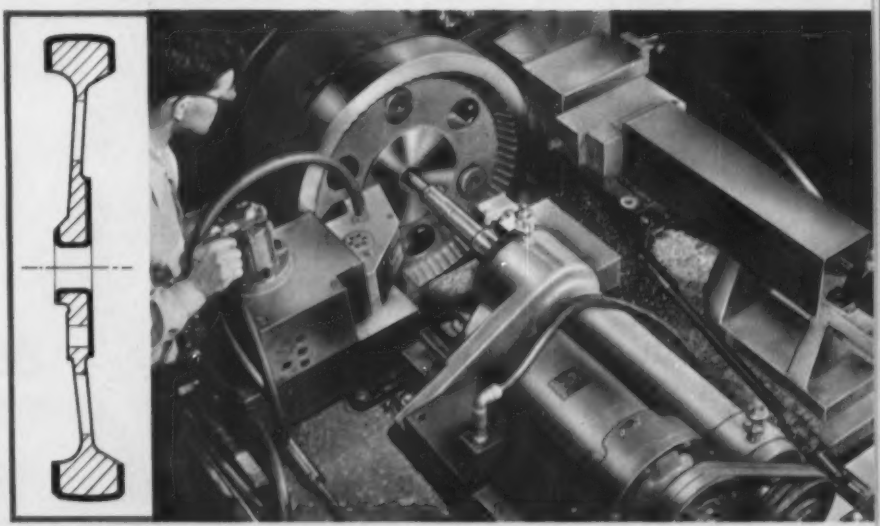
Simplimatic Automatic Lathe and Balancer Team Up to Drive Down Costs

All machining on this 320-lb. cast-iron hay baler flywheel is completed in one chucking on this Gisholt Simplimatic Automatic Lathe. The part is chucked in three cored holes in the web. V-grooves in the chuck jaws centralize the work and give a true-running web. Spring-loaded jacks provide support and eliminate vibration.

Four front slide tools straddle face the rim, face the center pad and chamfer the back edge. A cam-guided tool on the rear slide turns the OD crown and another tool chamfers the outer edge of the rim. Both slides have automatic tool relief. Two tools on a piloted speeder boring bar mounted on the center slide finish the bore and a third tool chamfers. A back boring attachment, operating through the spindle, completes the job by shave facing the back pad and chamfering the bore. Eleven tools machine ten surfaces in seven minutes f.t.f.

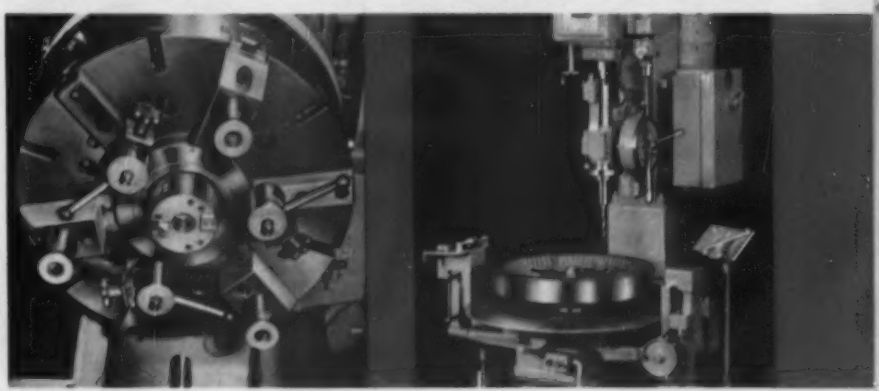
While a new workpiece is being machined, the operator places the completed part in a Gisholt 14E Static Balancer. This is arranged with correction equipment so that unbalance can be measured, located, corrected and inspected in one handling.

From rough casting to machined and balanced flywheel—all done by one operator and the two Gisholt machines.



Heavy lines show ten surfaces machined in one chucking.

Close-up of workpiece and tooling. Note speeder boring bar arrangement to give required cutting speed in small bore diameter.

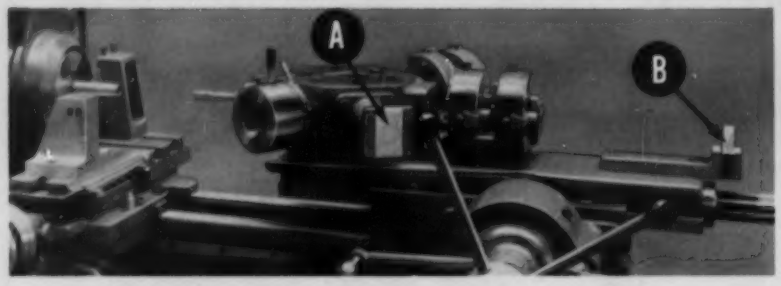


V-grooved chuck jaws and spring-loaded jacks. Back boring attachment tools feed out through the spindle to face back pad and chamfer bore.

Gisholt 14E Static Balancer with integral correction equipment. Up to 600 ounce-inches of unbalance can be quickly measured.

TIME-SAVING IDEAS

HOW TO DO LONG SHAFTS ON SHORT LATHE



Ram Type Machine Shows How Good Idea Can Save on Equipment Costs

The long and short of this pointer is worth remembering the next time you have a problem like it.

Here, a Gisholt No. 4 Ram Type Turret Lathe, which has 25¾ inches from hexagon turret face to spindle, is handling a 46⅝-inch-long shaft. The seamless steel tubing is fed through the spindle and locates against stock stop "A" for simple turning, reaming, necking and threading operations. Then the hexagon turret is indexed so that stop "A" again faces the work. The stop is hinged and flips up, permitting the bar stock to pass completely through the turret and locate against stop "B." The body of stop "A" acts as a steady-rest to prevent whip while the shaft is cut off to length from the rear tool post on the cross slide. Stop "B" then also swings out of the way for easy removal of the finished shaft. The whole job takes only 2.75 minutes floor-to-floor.

By simply allowing the workpiece to pass through the hexagon turret, a shaft nearly twice the length of the machine's capacity can be handled—sparing the need for a larger, more costly lathe.

TURRET-MOUNTED LOADER SPEEDS CHUCKING

Gisholt Fastermatic Automatic Turret Lathe uses Loading Arbor to Save Time and Effort.

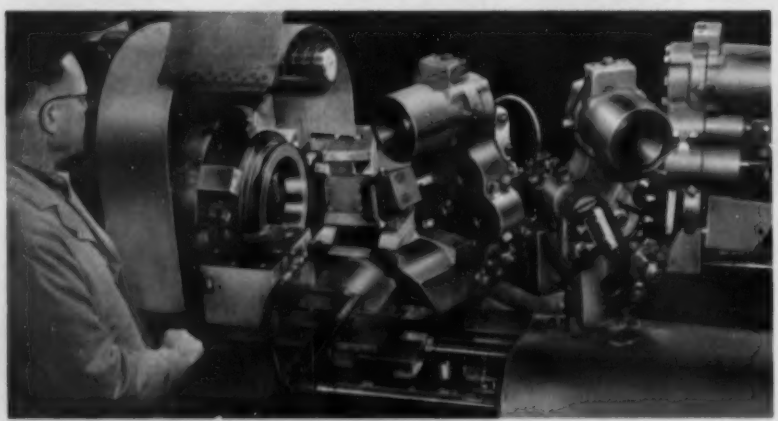
Even if you have your machining time down pat, you may still be able to cut over-all time further with a better loading method.

Here, to simplify and speed up chucking operations, this 2F Fastermatic has a special turret-mounted loader arrangement. As each machine cycle ends, the finished part is removed. Then forward movement of the hexagon turret carriage brings a rough workpiece on the loading arbor to the chuck. Spring-loaded studs on the arbor force the piece against the chuck jacks to locate the work.

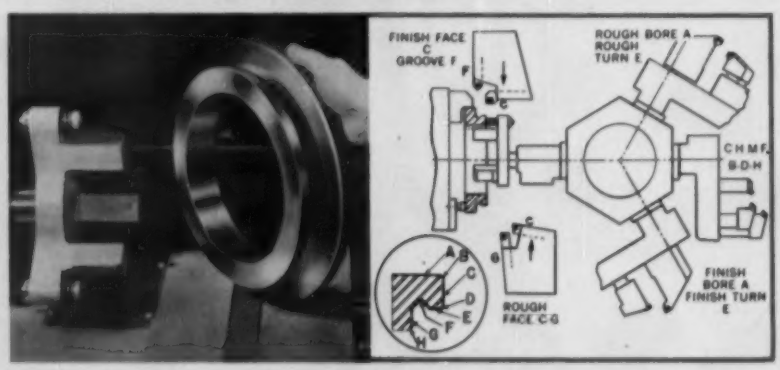
With simplified loading and chucking and a fully automatic machine cycle, time is just 6.9 minutes f.t.f.

The hexagon turret stations are tooled to turn, bore and chamfer with all facing and grooving operations on the steel rings performed from the front and rear cross slides.

Using a loading arbor on one turret face of the Fastermatic Automatic Turret Lathe reduces manual effort and simplifies chucking.



Tooling setup for first operation machining on steel rings.



Here's the special turret-mounted loader. Also a finished part showing surfaces machined.

GISHOLT

TIME-SAVING IDEAS

AUTOMATIC LATHE DOUBLES AT SUPERFINISHING AND BEARINGIZING

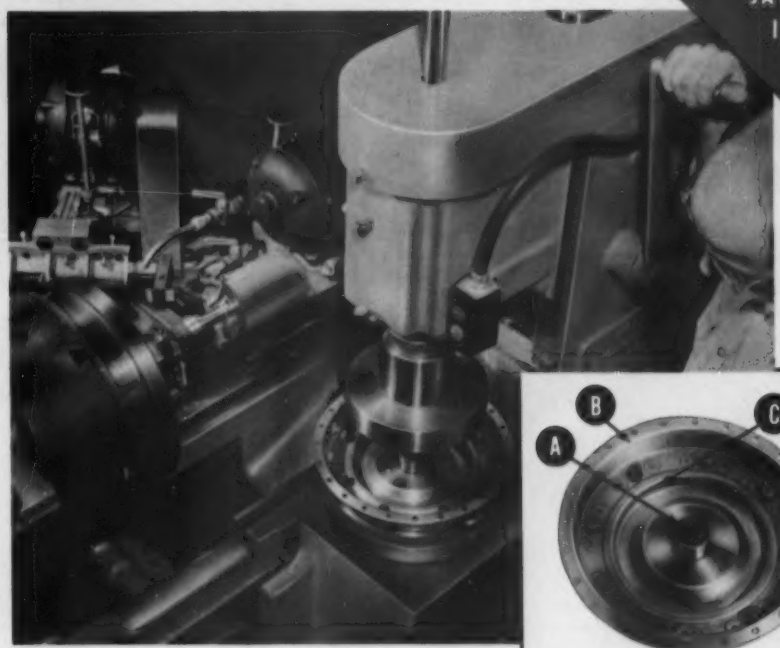
Gisholt No. 12 Hydraulic Lathe Adapts for Special Work

For many of those special jobs that come along present equipment can lend a hand. This unique application of a Gisholt No. 12 Hydraulic Lathe, where three jobs are performed in one handling, is a good case in point.

Here, it is specially tooled to finish automotive transmission converter clutch housing and bushing assemblies. Two No. 1 Superfinishing attachments are mounted on the rear independent slide. One Superfinishes the flat hub face (A) of clutch housing for thrust washer contact. At the same time the 45-degree sealing face (B) is also Superfinished.

While this part is being Superfinished, the preceding workpiece has its 8-inch bore (C) sized and finished by a vertical Bearingizer unit, also mounted on the No. 12 Hydraulic Lathe.

Production is fast—over 50 parts per hour. Tolerances are closely held and the required "controlled" surface finish readings easily obtained.



By simple adaptation, this No. 12 Hydraulic Automatic Lathe performs as a special machine to produce Superfinished and Bearingized parts.

To show tooling, Superfinishing quills are withdrawn, Bearingizer unit is raised. While part is Superfinished, another is Bearingized.

THREAD-GRINDING WHEELS BALANCED FOR MORE PRECISE WORK

Gisholt DYNETRIC Balancer Measures, Locates Unbalance to Eliminate Harmful Vibration

Thread-grinding wheels operate at high speeds and therefore must be very accurately balanced to eliminate vibration which would hamper grinding to close tolerances. For this type of workpiece, where the length along the axis is small compared to the diameter, correction is usually made only for force (static) unbalance.

For fast, simple, low-cost balancing this Gisholt Type 3S DYNETRIC Balancing Machine is used. It is easily set up to measure and locate force unbalance. The strobe lamp flashes on the numbered band and indicates which of the tapped holes provided in the mounting flange plate will receive the correction weight. At the same time, the amount meter tells the operator exactly which weight screw is to be added to bring the part into precise balance.

By eliminating vibration, grinding wheels rotate very smoothly and produce better threads to closer tolerances.



Balancing, performed on new wheels and after dressing old wheels, assures accuracy and improves performance.

DYNETRIC BALANCERS — GISHOLT

Complete courses covering all phases of precision balancing are offered by the *Gisholt Balancing School*. Get details and starting dates.

For A Clear Picture . . .



of the various plans under which you can acquire new machine tools, you'll find this a very helpful booklet. It explains and illustrates time-buying and leasing methods to show how you can benefit from these methods. Write for Booklet P-1173.

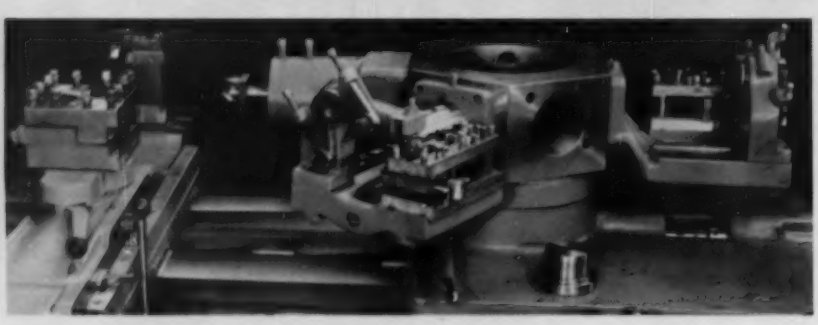
GISHOLT

GISHOLT

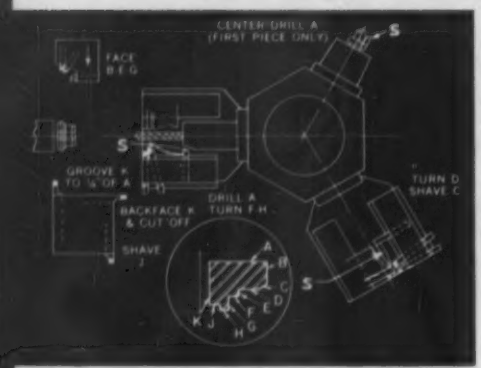
TIME-SAVING IDEAS

MULTIPLE TOOLING ANSWERS SMALL LOT PRODUCTION





This tooling arrangement makes an ideal setup for the various machining operations shown in the layout. As few as five pieces per lot are handled economically this way.



Saddle Type Lathe Produces Coupling Hubs Faster, More Accurately

Here a standard Gisholt 3L Saddle Type Turret Lathe is multiple tooled with lots as few as five pieces handled economically. The lathe is equipped with a bridge-type cross slide and is tooled to machine steel flexible coupling hubs from bar stock.

All tooling for the several different sized parts is pre-set. This includes the group of tools on the rear of the cross slide and also the special tool blocks held in the multiple cutter turners on the hexagon turret. To go from one part size to another, the operator merely changes these special tool blocks and adjusts the multiple cutter turner rollers. Special stops "S" on turret tooling determine the length of all turned diameters and shoulder positions directly from the end of the piece. These stops eliminate the time required to set turret stops. Also, a stock stop to position the work prior to starting machining operations is not required.

With this kind of interchangeable pre-set tooling on Saddle Type Turret Lathe, you have a high-production setup which can be used for small lots.

HOW SPOT CHECKING SAVES TIME ON SUPERFINISHING JOBS

Inspection Equipment on Machine Speeds Small Lot Operations



Operator is checking surface finish reading with inspection equipment mounted on Gisholt 51A Superfinisher.

Superfinishing, as you may know, is the process whereby a "controlled" surface finish can be quickly and economically obtained, piece after piece —whether the specified final finish is 50, 30, 10 or 1 micro-inch RMS.

In small job shop operations, various parts are handled and finish requirements vary considerably. This necessitates some means by which the operator can determine when he has produced the specified surface finish on a part.

This standard Gisholt 51A Superfinishing Machine is equipped with a Profilometer Unit. This provides a means of instant checking the surface roughness of the part being Superfinished at any time during the Superfinishing operation. The part doesn't have to be removed. It's possible to Superfinish each individual part to the blueprint tolerance before leaving the machine.

Superfinishing is made even more efficient and lower cost with this means of keeping a "running" check on surface roughness. It's ideal for handling small lots and where different surface finishes are specified.

Write for book, "Wear and Surface Finish" which gives full information on Superfinish.

No. 5-655
639

THE GISHOLT ROUND TABLE represents the collective experience of specialists in the machining, surface-finishing and balancing of round and partly round parts. Your problems are welcomed here.

GISHOLT MACHINE COMPANY

Madison 10, Wisconsin

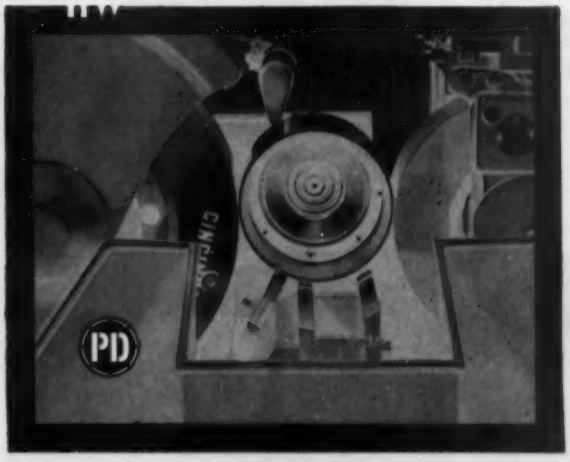
TURRET LATHES • AUTOMATIC LATHES • SUPERFINISHERS • BALANCERS • SPECIAL MACHINES

NOW!

Cincinnati Grinding Wheels offer

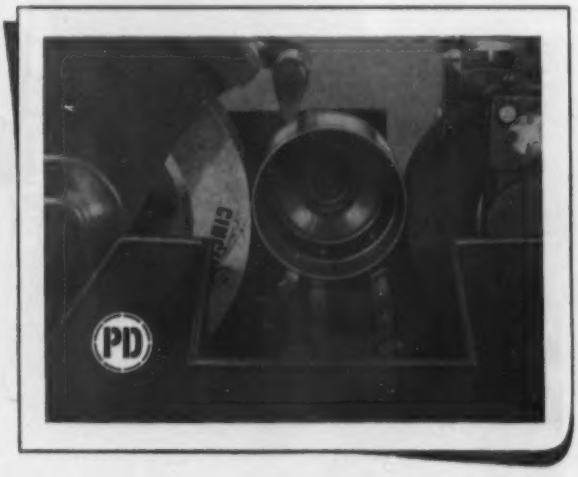
PD Positive Duplication

an outstanding development that will save you money and increase production



...POSITIVE DUPLICATION of an original grinding wheel each and every time through the CINCINNATI (PD) Manufacturing Process.

Just as a NEGATIVE guarantees you an exact duplication of a photograph each and every time, you are always assured a...



Positive Duplication is the best news in years for everyone who uses grinding wheels. And small wonder that (PD) is such big news! For here is a truly remarkable achievement in precision manufacturing and quality control that *absolutely can save you money . . . and increase your production.*

Through the CINCINNATI (PD) Manufacturing Process you are assured a Positive Duplication of the original wheel *every* time you reorder. "On grade" with a CINCINNATI (PD) WHEEL means all future (PD) WHEELS will act and grind exactly alike.

Yet CINCINNATI (PD) WHEELS *are priced no higher than ordinary wheels.*

We'll be glad to prove to you how CINCINNATI (PD) WHEELS can save you money and increase your production. Just contact us and we'll send one of our representatives—men who know grinding and grinding machines as well as grinding wheels. Write, wire or telephone Sales Manager, Cincinnati Milling Products Division, The Cincinnati Milling Machine Co., Cincinnati 9, Ohio.

CINCINNATI *Grinding Wheels*

NEW

PRECISION WAY to hob gears up to 23 ft. diameter

SCHIESS RF GEAR HOBBERS

Tremendous! Yes—and newly designed! Cut mammoth gears from 9 ft. to 23 ft. diameter with "lightweight" precision! Spur, helical and herringbone gears (including internal gears). Also wormwheels of either low- or high-lead angle.

Accurately centered fixed table supports blanks ranging from 20 to 80 tons. Moving column adjustable for both diameter of gear and depth of tooth. Cuts in either upward or downward direction. Huge master wormwheels assure accuracy of indexing movement. Tooth pressures of worms offset each other—no lateral stress.

SPUR GEARS cut by driving work table through index change gears connecting with hob spindle drive.

SINGLE HELICALS (or double helicals with teeth separated by gap) produced by additional table movement—by means of differential gear provided with change gears.

HERRINGBONES cut with end mills by means of single indexing method. Additional table motion achieved by same method used in helical hobbing.

WORMWHEELS for low-lead angle usually cut with parallel hobs by radial feed method. High-lead angles cut with tapered hobs and axial feed.

Four standard models—9′ 10″, 13′ 2″, 18′ and 23′ diameters. Products of Schiess, Europe's largest builder of heavy machine tools. Parts and service as close as Pittsburgh. An American Schiess engineer will be happy to help you decide how these heavy producers can serve your heavy production needs. Write for catalogs and complete specifications on all Schiess RF models.



Schiess Model RF 50/55 Gear Hobbing Machine cutting a 10½ ft. helical gear.

Engineering Division
AMERICAN SCHIESS CORPORATION
38th Street and AVRR, Pittsburgh, Pennsylvania

Sole Distributor
KURT ORBAN COMPANY, INC.
34 Exchange Place, Jersey City, N. J.

this 140-TON horizontal milling machine

There's never been one like it before!

Just a press of a button puts this mighty Schiess into action. A 25-ft. high column moves smoothly along 45-ft. long bedways. Never a vibration—no chatter—even at maximum transversal loads! The new Schiess design of the spindle heads has eliminated this!

THE MILLING OPERATION. A huge tungsten-carbide cutter in a 14¼" spindle goes to work on the stock. And performs its operation with a consistent accuracy—a surface-finish count—never before obtainable on such a big fellow.

THE BORING OPERATION. Another press of a button! Another spindle goes to work—bores a 79" depth in one cut—or a total depth of 118". Boring and milling spindles are provided with 36 speeds of which the top 12 are V-belt transmitted. Rapid traverse, feeds and manual controls of the two spindles are completely independent.

That this mighty machine has tremendous productive capacity is self-evident. And its productivity goes far beyond conventional milling and boring. Schiess attachments increase its scope to taper-milling, thread-cutting, copying and, in certain instances, copying in 3 dimensions. It's a time saver, too. Can go from feed to rapid traverse immediately, without complicated adjustments.

The Schiess Model FB 36/22.5 Horizontal Milling and Boring Machine is a product of Europe's largest builder of heavy machine tools. Parts and service are as close as Pittsburgh. An American Schiess Engineer will be happy to help you size up these heavy producers for your heavy production needs. Write for catalogs and complete specifications on all five FB models.

also bores and turns



Face milling entire side of 38' x 14' press frame on Schiess Model FB 36/22.5

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SEVENTY FIFTH

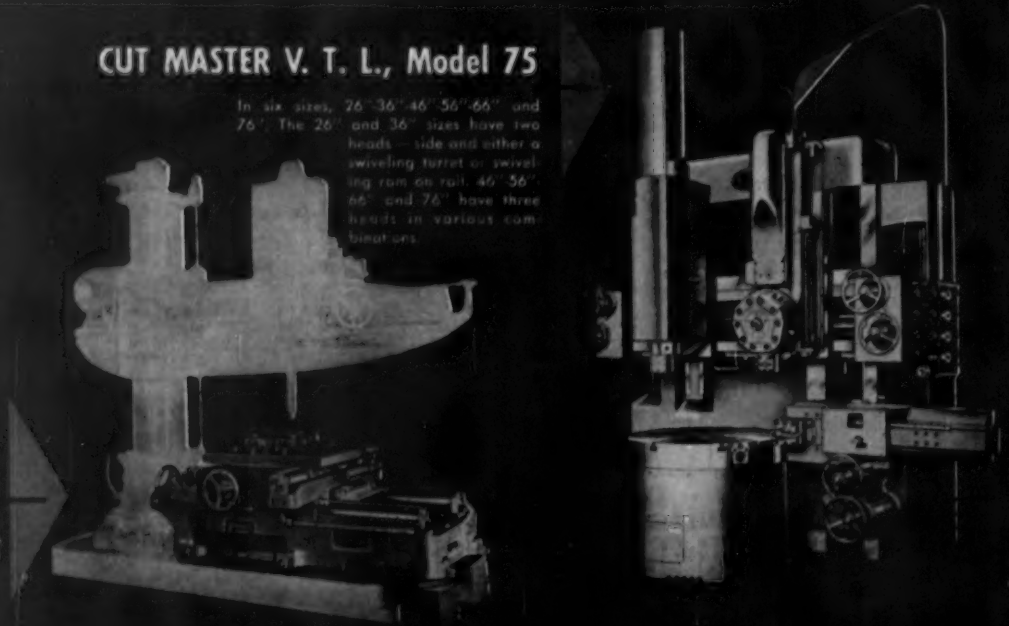
1880 BULLARD 1955

ANNIVERSARY

The name "Bullard" on machine tools stands for advanced design in engineering, quality of craftsmanship and reliable performance. Recognizing the improvements being made in cutting tools, methods and materials, Bullard Machine Tools have been designed, engineered and built to produce for your highest efficiency.

CUT MASTER V. T. L., Model 75

In six sizes, 26" 36" 46" 56" 66" and 76". The 26" and 36" sizes have two heads — side and either a swiveling turret or swiveling ram on rail. 46" 56" 66" and 76" have three heads in various combinations.

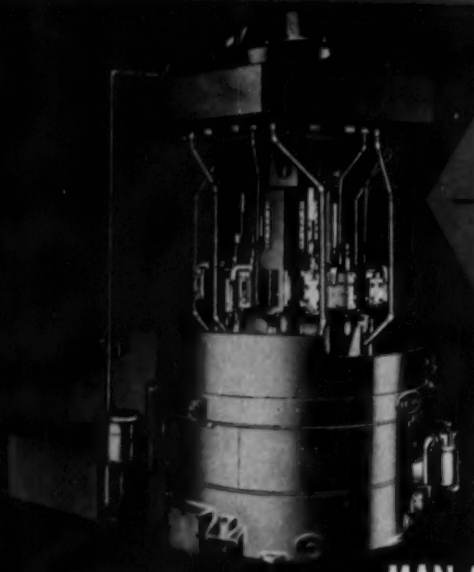


SPACING TABLE

30x20, mounted on super service drilling machines or 4' 5' and 6' radial drills.

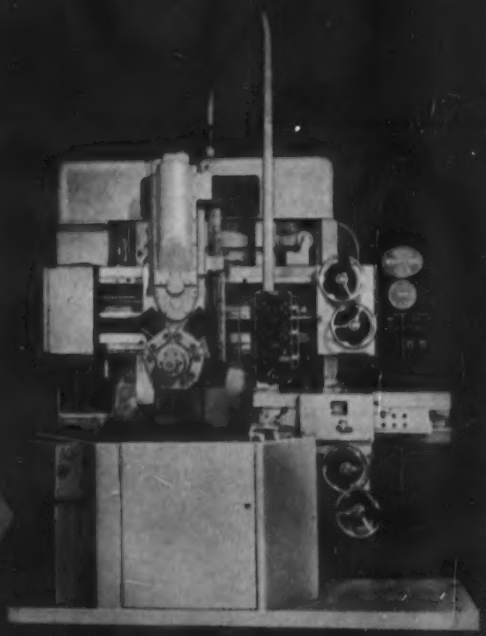
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manufacturers of .Modern Machine Tools....



CONTIN-U-MATIC

Type "RD" 4, 6 and 12 spindles in 10"-14"-20" sizes.



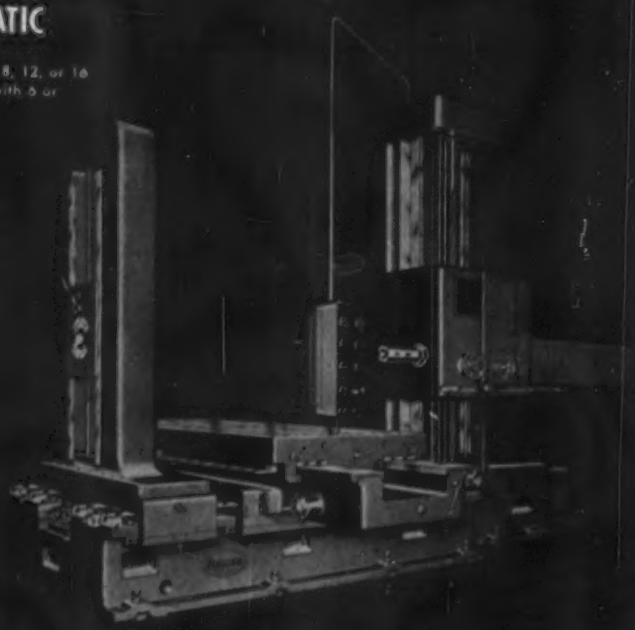
MAN-AU-TROL, Model 75

May be applied to any or all heads of Cut Master V.T.I. Model 75 at time of ordering or at a later date for fully automatic operation.



MULT-AU-MATIC

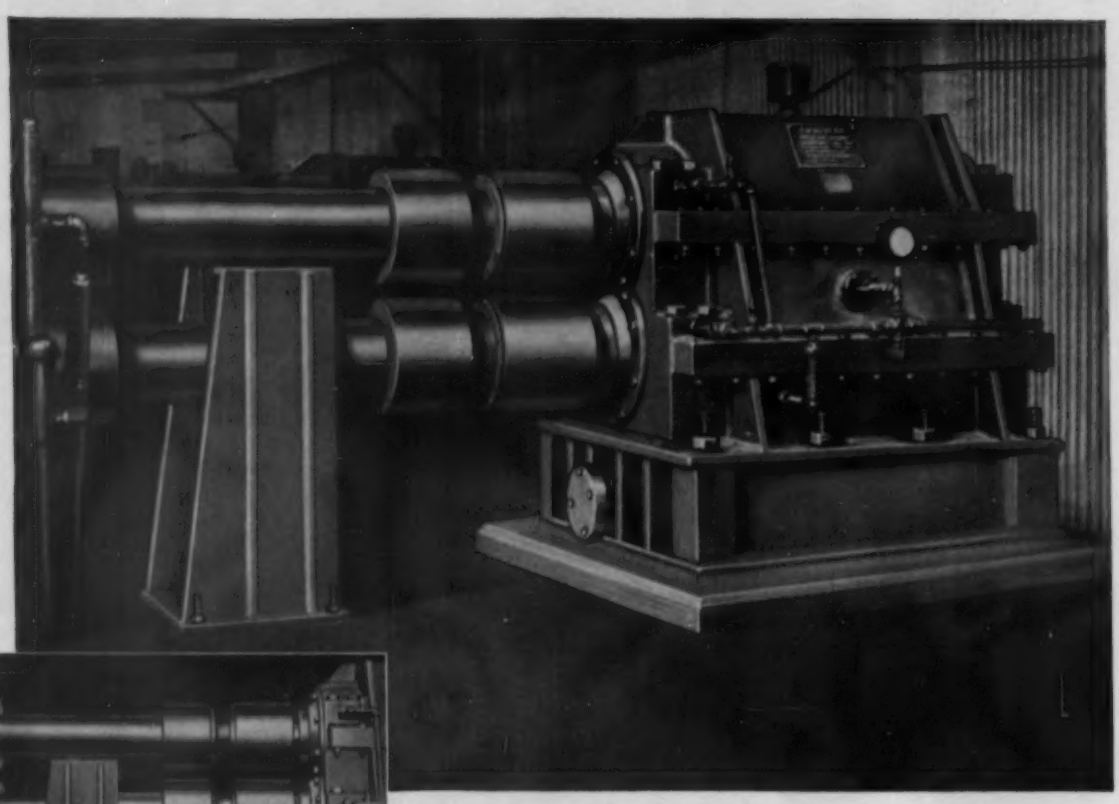
Type "L" — 10" with 6, 8, 12, or 16 spindles, 14" and 18" with 6 or 8 spindles.

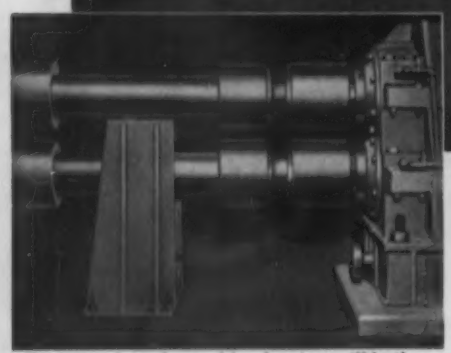


HORIZONTAL BORING, MILLING AND DRILLING MACHINES, Model 75

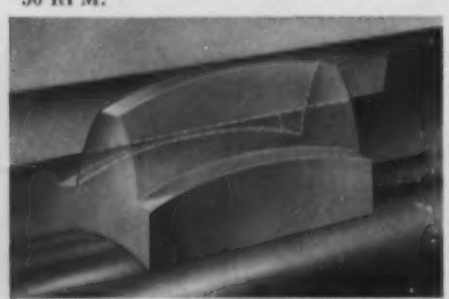
3", 4" and 5" spindle with various bed lengths and post heights.

IDGEPORT 2. CONNECTICUT





Four stand tandem cold reduction mill built by E. W. Bliss Company, of Salem, Ohio, for the Empire Steel Company, of Mansfield, Ohio. Equipped with eight "Sphereflex" roll shaft couplings, two couplings per stand, each coupling rated 750 HP at 50 RPM.



Cut above shows curved root and spherical tooth flank, which will compensate for any and all types of misalignment.

ROLL DRIVE COUPLINGS *by* PHILLIE GEAR®

The E. W. Bliss Company, Salem, Ohio, chose the "Sphereflex" spindle roll coupling in its design of a 4-Hi mill for the Empire Steel Company of Mansfield, Ohio. Designed for 6° angularity the couplings above offer higher efficiency, lower replacement cost and reduced maintenance than old style couplings.

EXCLUSIVE "SPHEREFLEX" TOOTH DESIGN PERMITS MAXIMUM ANGULAR CAPACITY WITH MINIMUM BACKLASH — PERMITS CONSTANT LINEAR ROLL SPEED WITH IMPROVED OPERATING EFFICIENCY.

The Sphereflex tooth, incorporating a curved pitchplane having a constant chordal thickness, results in a modified ball and socket joint so necessary for high operating efficiency of rotating equipment.

Let Phillie Gear help you design greater efficiency in your mill equipment.

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ERIE AVE. & G ST., PHILADELPHIA 34, PA.
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Industrial Gears & Speed Reducers

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Established 1892

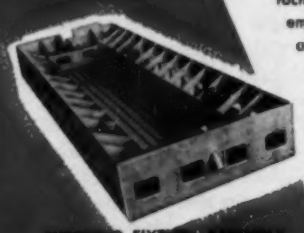
Plus Features in Weldments...

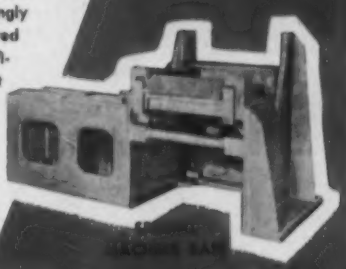
GREATER STRENGTH
+ MORE FLEXIBILITY
+ LESS WEIGHT
= *Savings in Costs!*





Engineered to meet their most complex requirements, hundreds of manufacturers of machine tools and heavy special machinery are increasingly employing Composite Forgings' weldments in their design. Pictured at right and left are a few of these fabrications. ★ Built-to-specification ruggedness and durability—easily modified to meet unforeseen needs—especially economical where time and pattern costs are a factor . . . these are the common-sense reasons why you, too, should consider Composite Forgings' weldments in manufacturing your product. ★ Backed by unmatched experience and facilities, you'll find Composite Forgings' specialists well qualified to handle your problem from blueprint to finished product, regardless of size, weight or complexity of design. A quarter-century's experience in welding "tailor-made" fabrications is your guarantee of complete satisfaction with Composite Forgings' weldments.







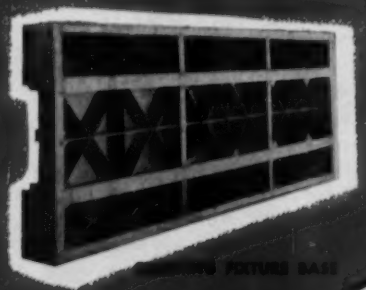


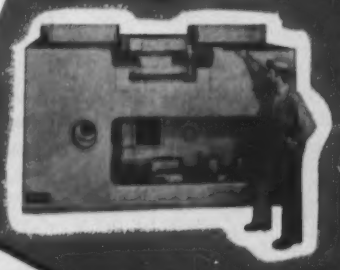
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Valuable booklet containing indexed weight tables, heat treatment, weights, circumferences of circles, etc.



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How Strong Arms Of Industry Get Their Muscles

Powerful arms of steel in the form of oil hydraulic cylinders are being used increasingly on industrial equipment, machinery, tractors, earth movers, loaders, lift trucks, portable drilling rigs. They transmit power smoothly, economically.

Among the producers of oil hydraulic cylinders, one of the largest and best known is the Commercial Shearing and Stamping Company of Youngstown, Ohio. It has developed precision methods of making heavy duty cylinders that operate easily, yet contain the oil hydraulic pressures without leakage. To make them, Commercial starts with the best in cold drawn seamless mechanical tubing from experienced steelmakers such as Pittsburgh Steel Company.

For example, take the double acting two-sleeve telescoping cylinder used to erect and lower the boom of a portable rotary drilling rig. Each rig is equipped with two of them. They have a stroke of nearly 10 feet, providing an initial thrust of 35 tons on the lift stroke and a thrust of nearly 20 tons on the pull stroke.

The cylinder operates under oil hydraulic pressure up to 1,000 psi. So the inside of the base tube, the outside and inside of the sleeve, and the outside of the plunger must have exceedingly accurate dimensional tolerances and must be polished to a mirror-like finish.

In production, these parts must be turned, ground and honed or polished. (Photo at left shows turning the sleeve.) The mechanical seamless tubing supplied by Pittsburgh Steel for this cylinder ranges in size from 7.210 inches inside diameter with a wall thickness of .395 inch for the main, down to 3.250 inside diameter with a wall thickness of .313 inch for the plunger.

It is a low carbon steel of inherent quality, cold drawn to exact uniform size for easy machining and honing. It is stress-relief annealed to prevent warpage during manufacture. And it provides a tensile strength of over 60,000 psi.

• **If you have an application for seamless tubing,** why not look into the opportunities Pittsburgh Steel can offer you? A phone call to the closest district office (see below) will bring prompt personal attention. Why not call today?

"Everything New But The Name"

Pittsburgh Steel Company

Grant Building • Pittsburgh 30, Pa.

DISTRICT SALES OFFICES: Atlanta • Chicago • Cleveland • Columbus • Dallas Dayton • Detroit • Houston • Los Angeles • New York • Philadelphia • Pittsburgh San Francisco • Tulsa • Warren, Ohio. **PLANTS:** Monessen, Pa. • Allenport, Pa. Akron • Los Angeles • Unionville, Conn. • Warren, Ohio • Worcester, Mass.

For the latest in

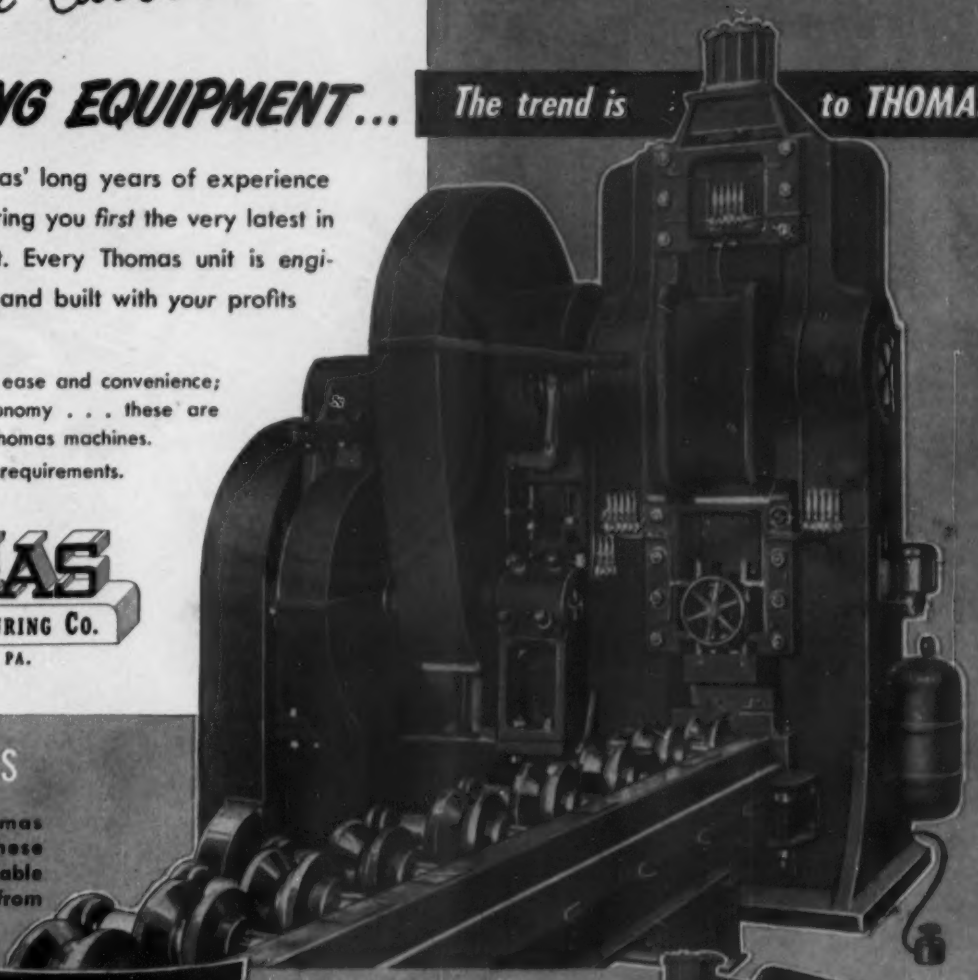
FABRICATING EQUIPMENT...

The trend is to THOMAS

You can rely on Thomas' long years of experience and "know-how" to bring you *first* the very latest in fabricating equipment. Every Thomas unit is *engineered* . . . designed and built with *your* profits in mind.

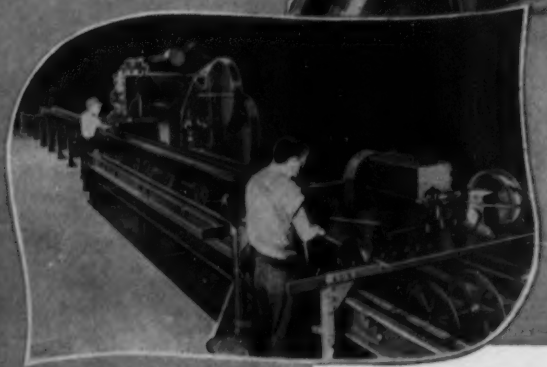
Practical utility; operating ease and convenience; flexibility, speed and economy . . . these are typical characteristics of Thomas machines. Permit us to quote on your requirements.

THOMAS
MACHINE MANUFACTURING CO.
PITTSBURGH 23, PA.



BILLET SHEARS

An example of Thomas advanced design. These Billet Shears are available in standard capacities from 500 to 2000 tons.



SPACING TABLES

This newest model was designed for the average steel fabricator, where economy and flexibility are so highly important. A worthy companion to the now famous Thomas automatic machine.



ANGLE BENDERS

This Thomas machine makes ordinarily slow and expensive jobs *fast and economical*. The all-steel angle roll is built in 4 different sizes and in 2 types.

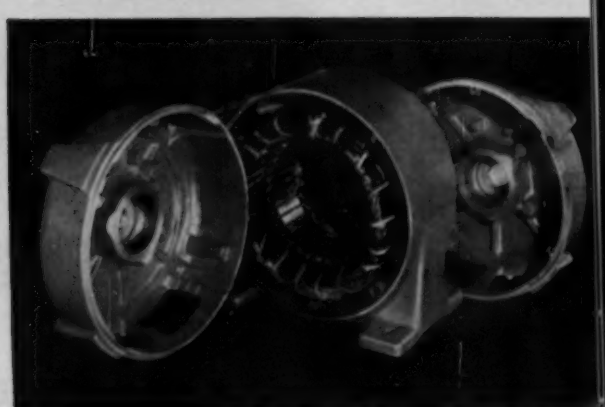


BAR SHEARS

This all-steel machine is offered in capacities of 50 to 400 tons. It may be tooled for various shearing operations or fitted with punching tools.

PUNCHES · SHEARS · PRESSES · BENDERS · SPACING TABLES

MOTOR FACTS ON INDUSTRY'S
MOST-PREFERRED "POWER PACKAGE"



Electrical System Fact: New fortified insulation includes exclusive Bondar, Bondite and Mylar* for greater protection against the toughest operating conditions.

*Du Pont registered trade-mark

FACT:

The new Life-Line A has stronger insulation than any other motor on the market

Meaning what? Simply that the new Westinghouse Life-Line® "A" motor with new fortified insulation can withstand heavier overloads and operate at higher temperatures than any other motor you can buy.

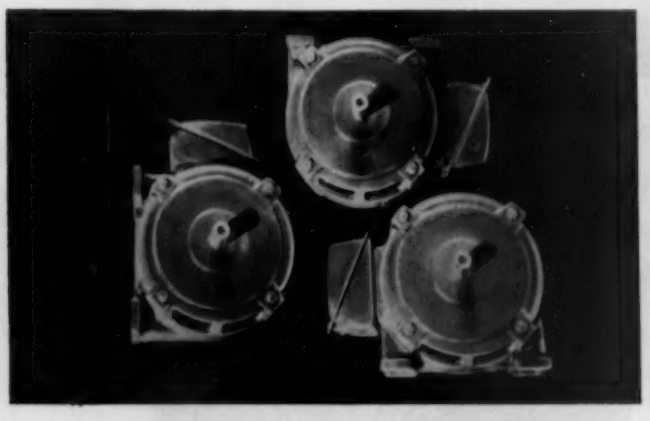
Similar design advances in the mechanical and lubrication systems make Life-Line "A" industry's most preferred motor.

It takes the right combination of *all three systems*—electrical, mechanical and lubrication—to build the best package of power on the market.

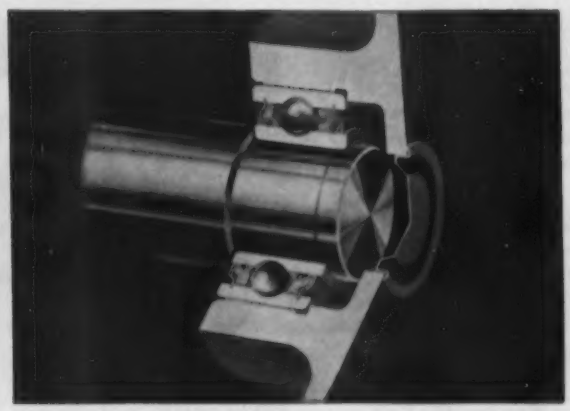
Get all the facts by calling your Westinghouse sales engineer . . . *The Man With The Facts!*

J-21877

YOU CAN BE SURE...IF IT'S Westinghouse

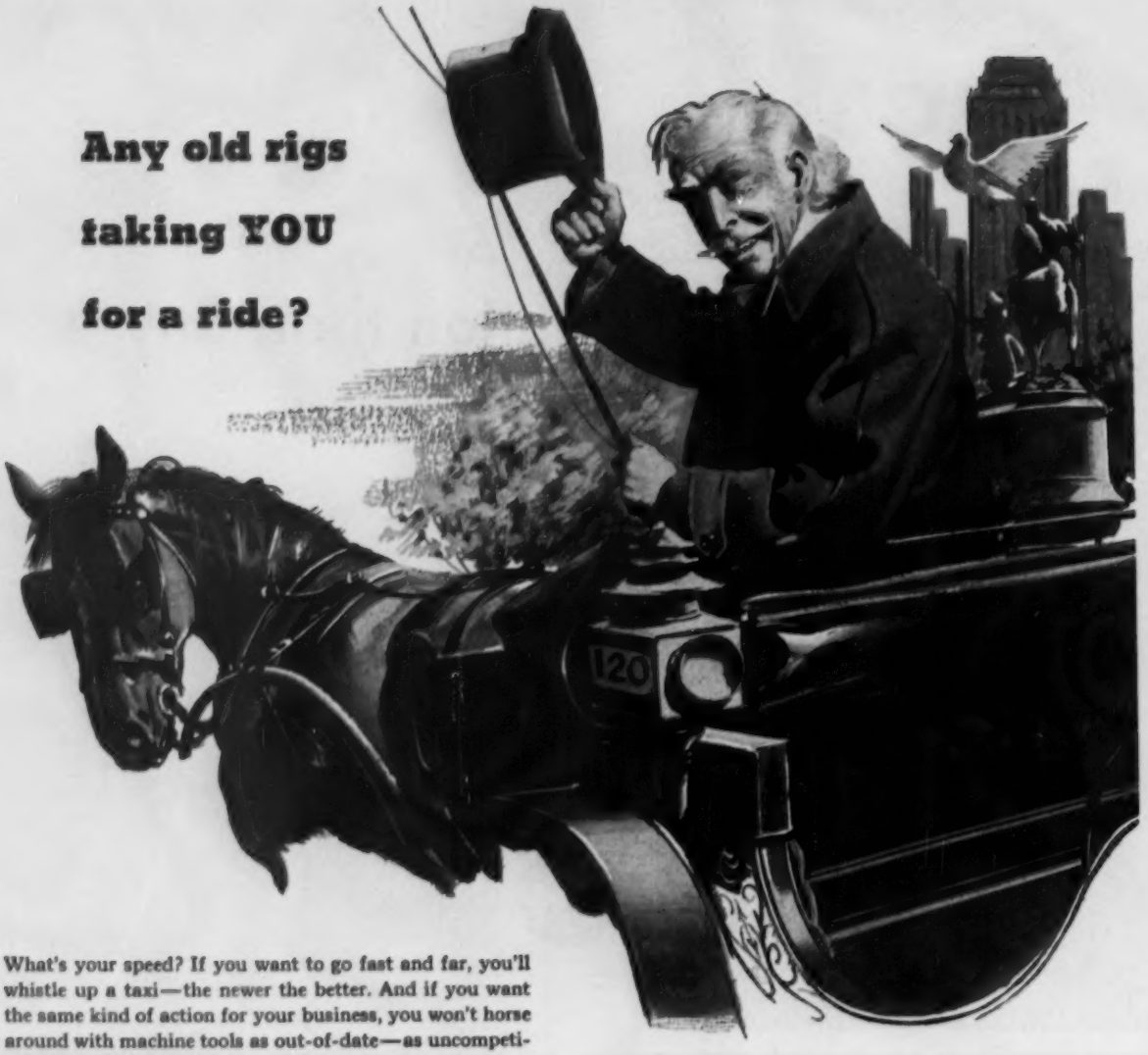


Mechanical System Fact: New cast-iron housing on both drip-proof and totally-enclosed types. Ventilation openings only in end brackets make the motor drip-proof whether mounted on floor, ceiling or wall.



Lubrication System Fact: New "4-way sealed", pre-lubricated bearing eliminates completely the 3 main causes of bearing failure: 1) contamination, 2) over greasing, 3) wrong grease.

Any old rigs taking YOU for a ride?



What's your speed? If you want to go fast and far, you'll whistle up a taxi—the newer the better. And if you want the same kind of action for your business, you won't horse around with machine tools as out-of-date—as uncompetitive—as this Victorian hot-rod.

OR DO YOU? More old lathes than you'd think are still ambling along in America's plants. Some of these are old at a comparatively youthful age. For every new machine that raises productivity and thus lowers costs, makes every less efficient one obsolete.

We submit that, unless you now use new Monarch lathes, you can't be sure of your position until you have secured comparative job studies. Do that—check the figures—and *know* where you stand. Then you'll discover full justification for getting down to cases with our sales engineers—acting on the proved business principle that it is machines, not dollars, that keep a plant competitive.

In other words, to keep ahead of competitive traffic, let us give you the facts so you will be certain to choose a fast, profitable production ride. Ask for brochures, catalogs, movies and job studies . . . *The Monarch Machine Tool Company, Sidney, Ohio.*

FOR A GOOD TURN FASTER . . . TURN TO MONARCH

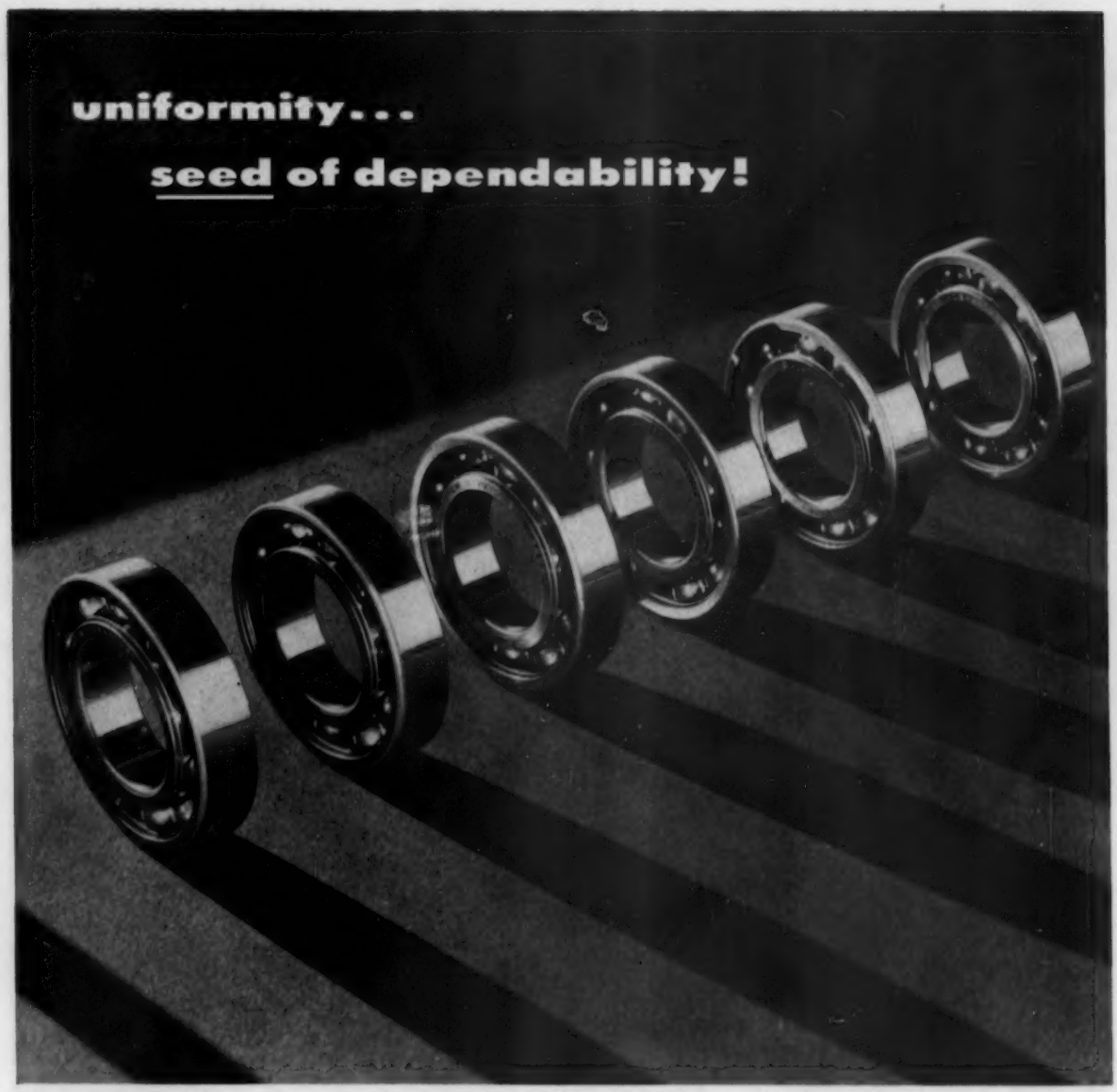
Monarch

ACCURACY • ECONOMY • LONG LIFE

TURNING MACHINES



GREATER PRODUCTIVITY of Monarch lathes stems from our continuous development and research program. It has, for example, been responsible for the Air-Gage Tracer method of cost reduction (above) which has received such widespread acceptance.



Not only in size or dimension but in every metallurgical or manufacturing detail, New Departure insists upon exceptional uniformity. As a result, the designer may select these ball bearings with the greatest possible assurance that their ultimate performance will completely justify his calculations.

New Departure Division, General Motors Corporation, Bristol, Connecticut.

NEW DEPARTURE
BALL BEARINGS
NOTHING ROLLS LIKE A BALL



The man who needs a new machine tool and doesn't buy it is paying for it anyway...

in extra operations

INDUSTRY lives with a continuing demand for higher performance and smoother, trouble-free operation of its products. Hence the need for closer tolerances and higher precision of parts, usually achieved through added production line operations and attendant higher costs.

Offsetting this trend toward added operations, Microhoning brings profitable relief. This unique process of controlled abrading can often replace two or more machining operations. Microhoning thus not only removes stock and generates geometric accuracy, but also insures dimensional precision and develops desired functional surface finish—all in one simple, automatic operation.

Why not analyze your processing operations to see how Microhoning—the machining process of multiple benefits—can eliminate some of the extra operations now causing you headaches and boosting your costs? In extra operations you may be paying right now the price of the new Microhoning equipment you don't have.





PART:

Diesel Fuel Injector Body. Long, small diameter bore must be straight and round.

PROBLEM:

To reduce high cost of operations required to generate accuracy.

SOLUTION:

Microhoning—Three operations replace six—size held to .000090 inch, finish 8 to 12 Microinches r.m.s.

*MICROHONING = STOCK REMOVAL + GEOMETRY + SIZE CONTROL + SURFACE FINISH

MICROMATIC HONE CORPORATION

8100 SCHOOLCRAFT AVE., DETROIT 38, MICHIGAN

MICROMATIC HONE CORP. MICRO-MOLD MFG. DIV. Boston Post Road, Guilford, Connecticut

MICROMATIC HONE CORP. 2205 Lee Street, Evanston, Illinois

MICROMATIC HONE CORP. 1885 Granda Vista Avenue, Los Angeles 23, California

MICROMATIC HONE LTD. 330 Grand River Avenue, Brantford, Ontario, Canada

MICROMATIC HONE CORP. MICRO-MOLD MFG. DIV. 231 So. Pendleton Avenue, Pendleton, Indiana

REPRESENTATIVES: Allied Northwest Machine Tool Corp., 103 S.W. Front Ave., Portland 4, Oregon • Mason Machine Tool Company, 415 So. Second East, Salt Lake City, Utah • Porpa Machinery & Supply Co., 1921 First Ave. South, Seattle 4, Washington

REPRESENTATIVES IN ALL PRINCIPAL COUNTRIES

MICRO-PRECISION DIVISION • 2205 Lee Street, Evanston, Illinois

Hydraulic controls • Diesel fuel injection equipment

Visit Booth 1211 at the Show. See other examples of how Microhoning saves extra operations.



"You cannot build today's products with yesterday's machines —*and be in business tomorrow!*"

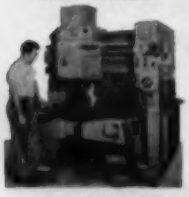
Quote from speech by Dr. W. W. Gilbert of the General Electric Company before the Machine Tool Distributors Meeting, Cincinnati, Ohio. Oct. 19-20, 1954.



New No. 4



New No.12



H. P.* No. 36

Up here in Vermont, we believe that Dr. Gilbert's statement is particularly pertinent to the production of precision gears in quantity. In our 1955 line are 'beefed up' ultra modern Gear Shapers... ready for automatic operation... faster stock removal... working to the ultimate in commercial precision limits.

Latest Heavy Duty Gear Shapers—for Production Savings

High Speed No. 4 GS for record-making production on work up to 6" diameter x 2" face.

No. 12 a high-spindle-speed, fast feed machine for all-purpose gears to 12" diameter x 4" face.

No. 36 is in wide use for coarse pitch pinions and gears in all diameters to 36" x 6" face.

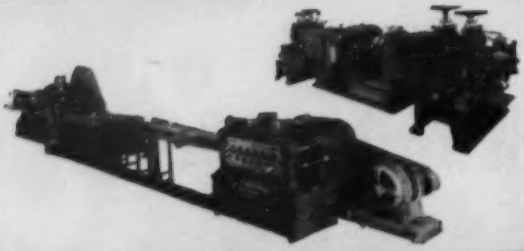
**High Production*

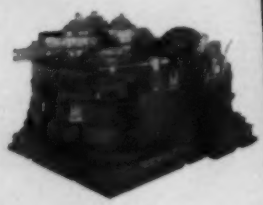
the IRON AGE 1855 · 1955

THE Fellows GEAR SHAPER COMPANY

Head Office and Export Department: 78 River Street, Springfield, Vermont • *Branch Offices:* 319 Fisher Bldg., Detroit 2
5835 West North Avenue, Chicago 39 • 2206 Empire State Bldg., New York 1 • 6214 West Manchester Avenue, Los Angeles 45

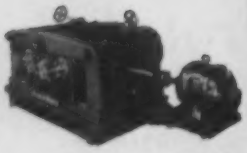






Metal Working Machinery

Standard or Custom Built to meet Every Production Demand

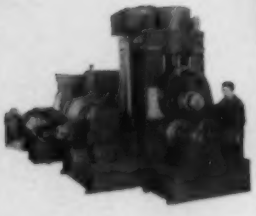




Solving production problems is our business. A letter, wire or phone call will place a qualified engineer at your disposal, quickly and without cost.

Get better production control . . . lower material costs . . . top speed and economy





Straightening Rolls
- Bar and Shape
- Single Plane
- Two Plane
- Sheet Leveler
- Rotary
- Core Wire

Bending Rolls
- Angle
- Pinch
- Hydraulic
- Wrapping

Forming Rolls

Slitters

Edgers

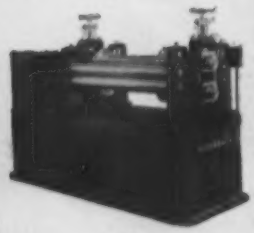
Crimpers

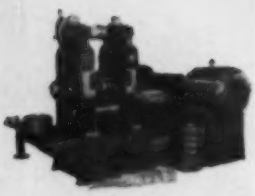
Mills

Flying Shears

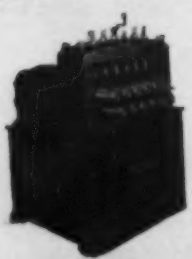
Flying Saws

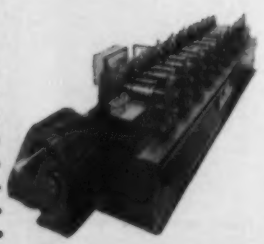
Special Metal Working Equipment









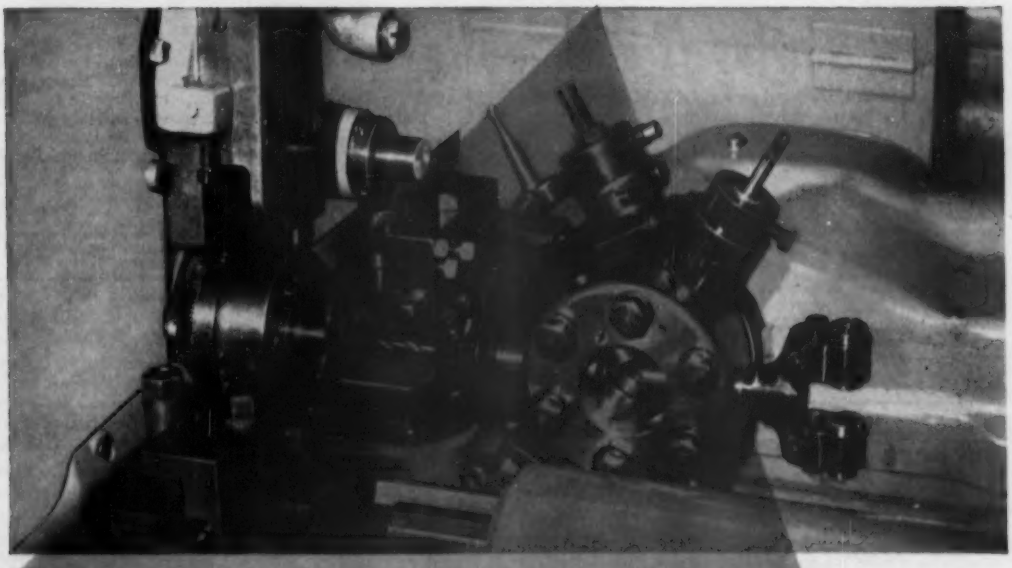


Represented in all principal cities in United States, Canada and abroad.

Kane & Roach

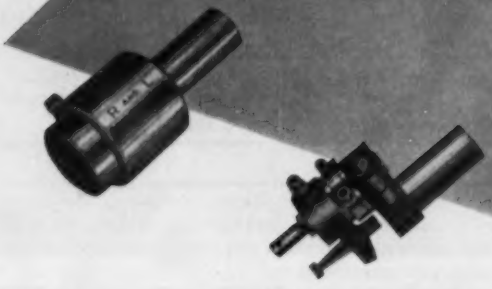
INCORPORATED

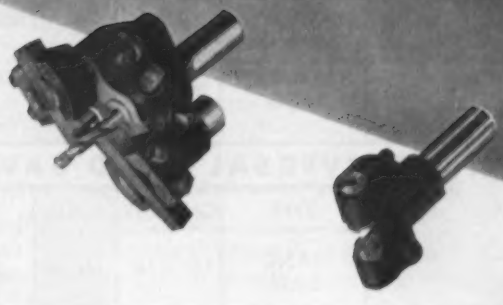
SYRACUSE, NEW YORK • ESTABLISHED 1887



A MACHINE IS ONLY AS GOOD AS THE TOOLS USED ON IT!

FOR PRECISION AND ECONOMY — R and L TOOLS ARE UNBEATABLE





That is why leading manufacturers* supply R and L TOOLS as original equipment with their machines. We know of no finer testimonial, with the possible exception of the fact that last year 86.7 of all R and L TOOL orders were *repeat orders* . . . Satisfied customers who wanted more of the precision, time-saving and money-making qualities built into every R and L TOOL.

***List of manufacturers supplied on request.**

Write for new catalog



CLIP AND MAIL THIS COUPON

R and L TOOLS

1825 BRISTOL STREET • PHILADELPHIA 40, PA.

TURNING TOOL • CARBIDE OR ROLLER BACKRESTS • RELEASING OR NON-RELEASING TAP AND DIE HOLDERS, (ALSO FURNISHED FOR ACORN DIES) • UNIVERSAL TOOL POST • CUT-OFF BLADE HOLDER • RECESSING TOOL • REVOLVING STOCK STOP • FLOATING DRILL HOLDER • KNURLING TOOL

☐ **Please send me your new catalog**

☐ **Please arrange for no-obligation demonstration of R and L TOOLS**

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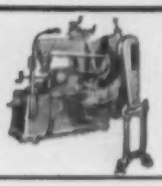
IA-6

Metal Sawing is of many types

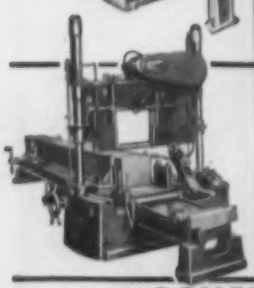
Requiring, for efficiency, sawing machines of varying characteristics, capacities, feed pressures, speeds . . . even different blade actions. The complete MARVEL Line comprises various basic types of metal sawing machines to meet the requirements of all shops.

Engineered to your jobs by a MARVEL Sawing Engineer, a MARVEL Saw is certain to lower your sawing costs (both blade cost and cost per piece); to cut-off more accurately (both in length and squareness) and to out-produce any other sawing machine of comparable specifications.

PRODUCTION HACK SAWS



TYPE	CAPACITY	MODEL	GENERAL APPLICATION
HACK SAW Single Cut	6″ x 6″	No. 6	These machines embody all of the modern design features of fine machine tools. They are recommended for constant heavy duty service, cutting all types of machinable metals. They should be selected whenever the work demands speed, accuracy, and stamina.
	10″ x 10″	No. 9	
HACK SAW Automatic Bar Feed	6″ x 6″	No. 6A	These automatic MARVEL saws use the No. 6 and No. 9 as a basic unit, but are modified to include an automatic mechanical bar feeding mechanism. Their purpose is to automatically "cut-up" long bars into multiple short length pieces without constant attention of an operator.
	10″ x 10″	No. 9A	
HACK SAW Dual Bar Feed	10″ x 10″	No.9A3	The No. 9A3 machine combines full automatic operation and manually controlled power feed, the latter for lengths beyond practicability of full automatic operation.
HACK SAW Hydraulic Roll Stroke Single Cut	18″ x 18″	No. 18	These big saws are proof that the hack saw method is entirely practical for cutting off big pieces of the toughest steels. Low investment, economical operating and maintenance cost, accuracy and cutting speed make these machines an ideal tool for the steel mill, warehouse and forge shop.
	24″ x 24″	No. 24	
HACK SAW Power Work Handling Type	18″ x 18″	No.18B	The No. 18-B is a special structural saw, primarily designed to obtain accuracy to such a degree in cutting structural shapes that subsequent face milling is not required.



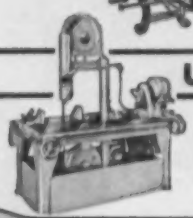
GENERAL PURPOSE HACK SAWS



TYPE	CAPACITY	MODEL	
HACK SAW Single Cut	6″ x 6″	No. 4B	This saw is fast, accurate, yet moderately priced. For intermittent service, to cut off all types and shapes of machineable metal. Recommended for use in the tool room, maintenance department, and machine shop.
HACK SAW Single Dry Cut	4″ x 4″	No. 1	The most popular mechanical saws on the market for occasional cut-off work. Sturdily built, easy to operate, low in price, they are ideal for the small shop where speed is not essential.
	6″ x 6″	No. 2	



UNIVERSAL BAND SAW



TYPE	CAPACITY	MODEL	
BAND SAW	18″ x 18″	No. 8	The MARVEL No. 8 Band Saw is designed primarily for universal work. It will trim, miter, notch and cut-off bar stock, pipe, structural sections, mouldings and tubing. No other saw of any type is capable of handling the wide range of unusual cutting jobs possible on this very versatile machine.

HACK SAW BLADES—*High-Speed-Edge*



COMPOSITE UNBREAKABLE

The original composite blade with a fast-cutting, long-lasting high speed steel cutting edge integrally welded to a tough, non-breakable alloy steel body. These superior blades improve the efficiency of ANY hack saw machine because they will withstand heavier feed pressure, higher tension, and faster speeds. A type and size for every hack saw, for every machineable material.

HOLE SAWS—*High-Speed-Edge*



HEAVY DUTY FOR MACHINE TOOLS

Permit sawing-out of large holes (to 4½" dia.) in steel plate (to 1½" thickness) with small capacity machine tools and portable tools. Heavy duty arbors and 1-piece floating, self-aligning, High-Speed-Edge saws. This new type hole saw, developed by MARVEL, provides a fast, low-cost method for making large holes, an operation previously requiring much machining or large equipment.

BAND SAW BLADES



WELDED TO SIZE INDIVIDUALLY PACKAGED

Through exhaustive tests MARVEL has determined the type of set—raker or wavy—best suited for all-around cutting on every standard make and model metal band saw. These exactly suited blades come welded to size, ready for use, and individually packaged.

Write for Catalog

ARMSTRONG-BLUM MFG. CO.

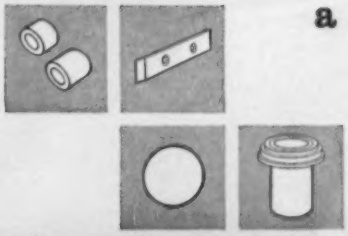
5700 West Bloomingdale Avenue • Chicago 39, U.S.A.

MARVEL Metal Cutting SAWS — Better Machines-Better Blades





KENNAMETAL*...in existence for only a fraction of a century ...has created a NEW ERA in Metalworking





A whole new concept of machining steel was introduced in 1938 with the development of Kennametal sintered carbide compositions, the first carbides to successfully machine steel.

These hard, strong and long-wearing Kennametal compositions cut steel from three to ten times faster than tools made of high-speed steel . . . and lasted very much longer. Production soared. Machining costs dropped. Downtime shrank.





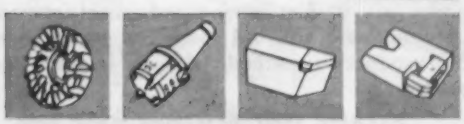
Thus, one of the greatest steps toward machine shop automation was made.

Kennametal today makes available the most complete line of superior sintered carbide tools ever offered—for metal turning, facing, chamfering, profiling, cutting, drilling, boring, grooving, milling, planing and broaching. Kennametal carbide compositions are created for specific metalworking applications where any one or a combination of the following properties are required: high hardness, great strength, and resistance to heat, impact, abrasion, adhesion, corrosion and vibration.











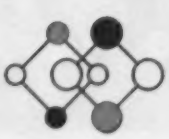
These compositions will help to make the coming years significantly greater than any similar period in the past.

If you have not yet tried Kennametal, send for the facts today. Our engineers will gladly discuss your problem with you and recommend the right tools or grades for critical parts in machines or processing equipment. Write to KENNAMETAL INC., Latrobe, Pa.

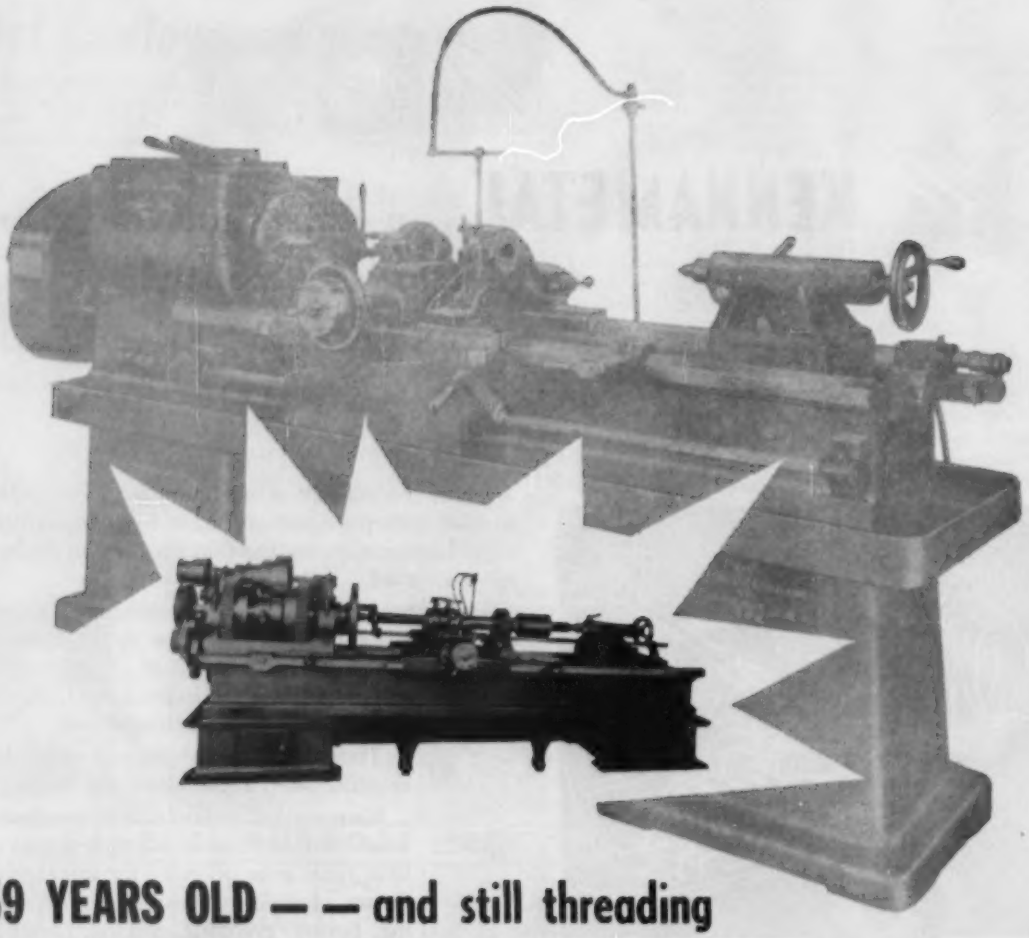
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9972





INDUSTRY AND
KENNAMETAL
...Partners in Progress



59 YEARS OLD — — and still threading

SKINNER precision CHUCKS *AUTOMATICALLY*

Machines have their story to tell. Like men, good machines never lose their precision. They simply get left in the lurch by progress.

New cutting steels, faster engines, quicker feed methods hasten retirement of older machines. For, what was high production in 1896, is but a trickle today.

In 1896 the SKINNER CHUCK COMPANY, of NEW BRITAIN, CONN. invested in their first COULTER to thread their famous line of scroll chucks. Today, SKINNER still depends on Coulters, because they perform *automatically*. The "grand-daddies" are put to part time work, so that SKINNER can devote its fast new Coulters to the job of high speed production.

Big Coulters — lathes with 4-speed headstocks, and return and idle speeds *5 times cutting speeds*. Fast Coulters — threaders with starting and stopping levers within quick reach of the operator, and individual adjustments to both front and rear tool slides.

These hungry Coulters, and machines like them, often replace one, two — sometimes three — older machines. And — because of their advance design — they turn out four times the work at half the cost. Periodic retirement of older machines often spells the difference between a high and a low production figure. It does for SKINNER. Chances are it can for you.

Coulter's booklet "Automatic Threading Lathes" gives you a first-hand standard of comparison between new and old machines — and new and old production methods. A copy is yours for the asking.

MACHINE TOOL BUILDERS SINCE 1896

James Coulter Machine Co.

626 Railroad Ave. Bridgeport 5, Conn.

For Coiling and Sheeting Applications



Stamco has equipment available in a wide range of sizes and speeds for coiling and sheeting applications in mill, warehouse or factory. These bulletins tell the complete story. Request them by number on your letterhead. No obligation.

STAMCO, Inc., New Bremen, Ohio

Another Transfer-matic by Cross

350 Foot Automation Line Performs 555 Operations on V-8 Cylinder Blocks



- ★ 100 pieces at 100% efficiency.
- ★ Operations: 265 drilling, 6 milling, 21 boring, 56 reaming, 101 countersinking, 106 tapping, and 133 inspection.
- ★ 104 stations: 1 for loading, 53 for machining, 7 for part handling, 6 for mechanical inspection, 36 for visual inspection, 1 for unloading.
- ★ 5 independent machine sections with provision for banking parts between each section; master automatic cycle for operating all 5 sections simultaneously.
- ★ Capacity for removing work piece at every station.
- ★ Automatic independent transfer mechanism for each machine section and automation units for handling parts from machine section to machine section.
- ★ Automatic air pressure test for high pressure oil holes and automatic depth inspection for all holes before tapping.
- ★ Pre-set tooling throughout.
- ★ Other features: Coolant system for tapping section, complete interchangeability of all standard and special parts for easy maintenance, construction to J.I.C. standards, hardened and ground ways, hydraulic feed and rapid traverse, automatic lubrication, automatic chip disposal.

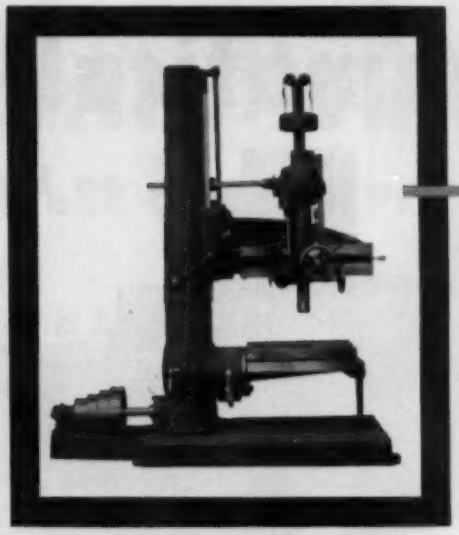


Established 1898

THE CROSS CO.

DETROIT 7, MICHIGAN

Special MACHINE TOOLS



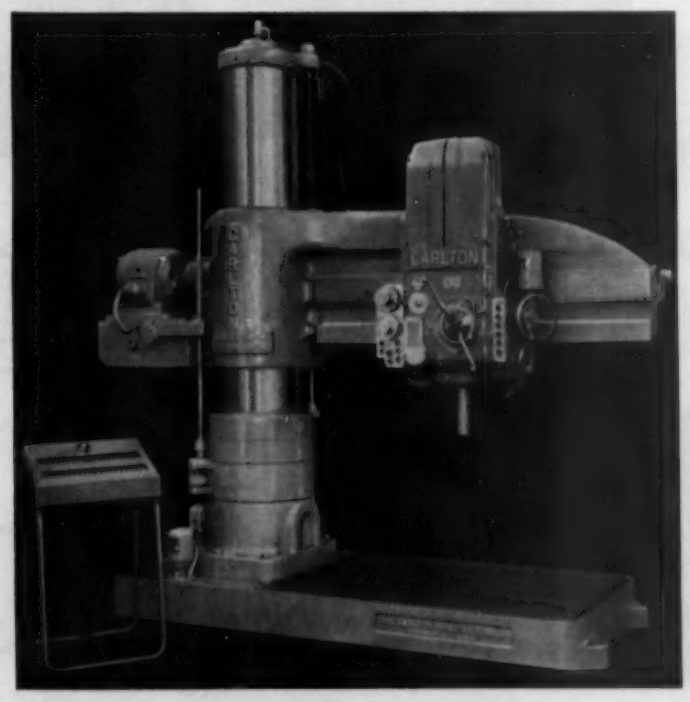
CARLTON	1916 Style D	1955 Model 4A
Speeds, number	4	36
Speeds, maximum, rpm	450	2000
Feeds, number	1	18
Main drive motor, hp	line shaft	25
Bearings, type	plain	anti-friction
Lubrication	manual	automatic
Spindle diameter at point of drive	1 15/16"	4"
Vertical travel of spindle	8"	20"
Traverse of head on arm	40"	59"
Traverse of arm on column	32"	44"
Shipping weight, lbs.	3000	26,335

Carlton RADIAL DRILLS

continuously improved since 1916 . . .

better than ever today . . . now available with

pre-selector and programming device



The belt driven Style D Carlton radial drill (above)—an advanced design model when introduced in 1916—looks pretty old-fashioned today.

And indeed it is. For Carlton radial drills today are ever so much faster and more powerful. And thanks to two sensational Carlton developments, Carlton radial drills can be made *almost completely automatic:*

Carlton Pre-selector: Allows operator to set speed and feed for the next operation while machine is drilling.

Carlton Programming Device: A 20-station device that allows you to index in advance up to 20 speeds and feeds. Your production planning department can set up the entire program of speeds and feeds for a given job.

Both the Carlton Pre-selector and Programming Device are now available as extra equipment. For the most dramatic radial drill demonstration ever, see them in action in our booth at the Machine Tool Show. The Carlton Machine Tool Co., Cincinnati 25, Ohio, U.S.A.

Acme-Gridley automatically

on both

*gives you 3 to 5 times * faster production —*

on CONTROLLED SCHEDULES



Model MC Chuck-Type Acme-Gridley Fully Automatic Turret Lathe—rated capacity 12".

How? **All machining operations are in a fixed sequence—automatically timed and controlled. Machining is done at the surface speed best suited for required finish and tolerance (using high-speed or carbide tooling) because each toolslide is independently cammed and selective spindle speeds are automatically controlled during the cycle.**

With automatically controlled cycle operation—standard on ALL Acme-Gridleys—you get uniform precision on piece after piece at the same predetermined machining rate at the end of a shift as at the start.

And because more secondary operations can be accomplished in one machine set-up, these newest Acme-Gridleys further reduce costs through savings in man hours, additional machines and floor space.



Model M Bar-Type Acme-Gridley Fully Automatic Turret Lathe—built in 3 sizes—3½", 4¾" and 5½" rated capacities.

* **Users invariably get more than double the production of former methods, even though they were using up-to-date equipment. 5 to 1 gains are not unusual. Some have shown as high as 10 to 1. Ask us to help you make the comparison on your jobs.**

THE ONLY *COMPLETE LINE* OF PRODUCTION TOOLS *FROM ONE SOURCE*

(Catalogs on request)

MULTIPLE SPINDLE AUTOMATICS • **BAR TYPE—Sizes ⅛ to 7¼"—4, 6 and 8 Spindle. CHUCK TYPE—Sizes 5¼ to 12"—4, 6 and 8 Spindle.**

AUTOMATIC TURRET LATHES • **BAR TYPE—Sizes 3½ to 5½"—Single Spindle. CHUCK TYPE—12" capacity—Single Spindle.**

THE CHUCK-MATIC • **Single Spindle Chucker—12" capacity.**

THREADING TOOLS • **Vers-a-tool Threading Heads** • **Namco Collapsible Taps** • **National Acme Thread Rolling Heads.**

NATIONAL ACME THREAD ROLLING MACHINES

B.S.A. SINGLE SPINDLE SCREW MACHINES • **Capacities ½ to 2". National Acme sole agents and distributors in the U.S.A. for these British-built automatics.**

The NATIONAL ACME COMPANY

170 EAST 131st STREET • CLEVELAND 8, OHIO

controlled cycle time

BAR and CHUCK-TYPE FULLY AUTOMATIC TURRET LATHES

TIME SAVED

ON THESE ACTUAL JOBS ON MODEL MC CHUCK TYPE

(Total floor-to-floor time for 1st and 2nd operations)







	Finger Holder Body	Master Collet Blank	Bearing Retainer
Description of piece.....			
Material.....	6⅝" dia. Semi-Steel	6" dia. 4160 Steel (Solid Slug)	9¼" dia. Lumen Alloy
Time per piece—former method	39.2 minutes	98 minutes	17.3 minutes
Time per piece—MODEL MC..	11.2 minutes	35.4 minutes	6.0 minutes
	Saving 28 min.	Saving 62.6 min.	Saving 11.3 min.

TIME SAVED

ON THESE ACTUAL JOBS ON MODEL M BAR TYPE





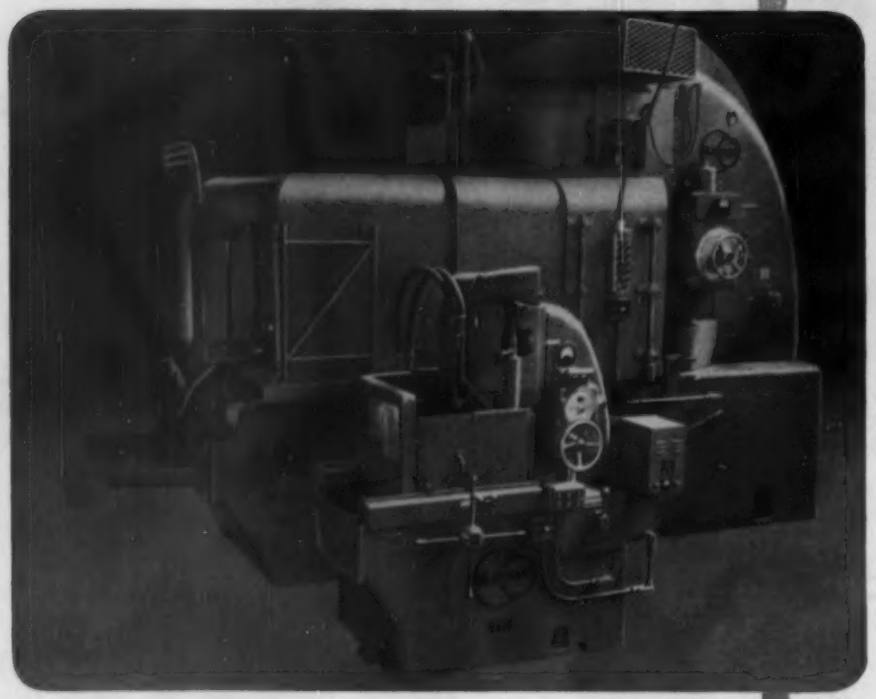


	Sleeve 4 x 3¼" long	Whirl 3½ x 4⅝" long	Pilot Stud 1⅞ x 6" long
Description of piece.....			
Material.....	1112 Steel	Leaded Open Hearth Steel	A-4615 CR Steel
Time per piece—former method	30 minutes	21 minutes	17 minutes
Time per piece—MODEL M...	6 minutes	5.7 minutes	7.5 minutes
	Saving 24 min.	Saving 15.3 min.	Saving 9.5 min.

production suggestion:

TEAM UP ACME-GRIDLEY SINGLES as best suits your job. The combinations are almost limitless. For example, use the Model M bar-type for first operation work—continuous from the bar—with second operation work on the opposite end on the chuck-type Model MC at the same time; or use either two bar-type or two chuck-type machines for both operations. This TEAM METHOD eliminates much of the handling and saves floor space (you don't have to store semi-finished parts while awaiting the second operation setup) and, depending on the job time cycle, one man can run the whole job.

Or, team up either or both of the automatic turret lathes with the Acme-Gridley Chuck-Matic—a radically different single spindle chucker of 12" capacity—for short length primary operations such as forming, turning, straight or taper boring etc. The Chuck-Matic has automatic cycle time control, too.



V-488



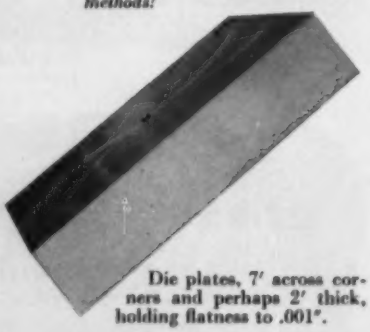
Tiny watch gears, pinions and ruby bearings — flat and parallel — to a dimension tolerance of .0002".



To 3 micro-inches and flat within *one* light band.



Hardened steel machine tool ways, 2½" x 3½" x 50", ground on 6 sides, flat within .001" with surface finish of 5 micro-inches — *5 times faster than other methods!*



Die plates, 7' across corners and perhaps 2' thick, holding flatness to .001".

Please give us a chance!

We *know* we can do *your* flat surface jobs. We've done them all — tiny watch parts . . . steel plates 7 feet across corners . . . copper and ceramics . . . *perfectly*. Just give us the correct wheel . . . (Blanchard wheels are preferable).

Blanchards regularly grind surfaces flat to within 2 to 4 light bands, parallel to less than .0001", with dimension tolerance of .0002" and surface finish to better than 3 micro-inches.

Honest, we Blanchards (15 models) work fast and inexpensively — whether the job requires precision grinding or rapid removal of stock. Give us a chance to prove we're the best investment you ever made.

VISIT BLANCHARD BOOTH NO. 406
AT THE MACHINE TOOL SHOW



Send for free copies of "Work Done on the Blanchard" (fourth edition), and "The Art of Blanchard Surface Grinding".

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ARMSTRONG

Quality TOOLS



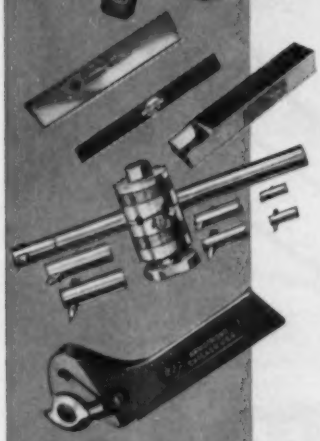


More than meets the eye

There are extra values in ARMSTRONG TOOLS that become apparent only with use.

TOOL SENSE— convenience in use — the most efficient *"tool approach"* built into ARMSTRONG Tool Holders; the balance and *"feel"* of an ARMSTRONG Wrench; the *rigidity* of ARMSTRONG "C" Clamps; the extra *toughness* of ARMSTRONG Lathe Dogs and Eye Bolts; the universal *adaptability* of ARMSTRONG Set-up and Hold-down Tools — the evidence of "tool sense", the understanding of each tool's requirements.





STRENGTH — built into each individual ARMSTRONG TOOL is a safety factor of extra *strength* — *strength* beyond any need, the inherent strength of specially selected materials enhanced by proper heat treatment and hardening.





UNIFORM QUALITY — the uniform quality made possible by modern manufacturing methods, in a specially-built plant equipped with every needed quality control. The name ARMSTRONG with the Arm-and-Hammer Trade Mark is universally recognized as a guarantee of finest quality.









ARMSTRONG BROS. TOOL CO.

"The Tool Holder People"

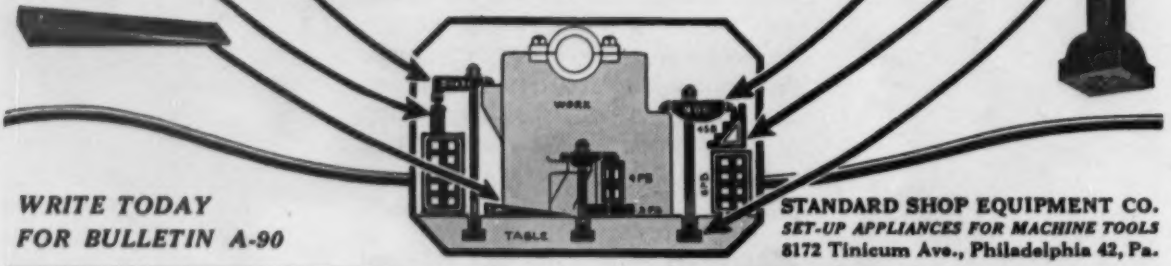
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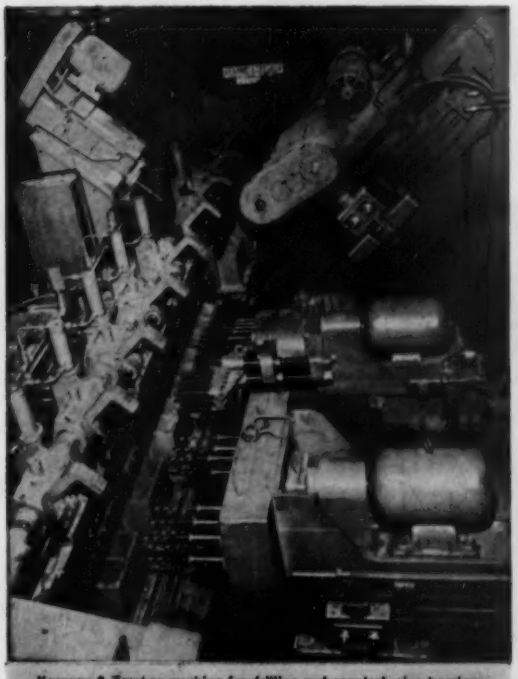
DYKEM HI-SPOT BLUE No. 107 is used to locate high spots when scraping bearing surfaces. As it does not dry, it remains in condition on work indefinitely, saving scraper's time. Intensely blue, smooth paste spreads thin, transfers clearly. No grit; noninjurious to metal. Uniform. Available in collapsible tubes of three sizes. Order from your supplier. Write for free sample tube on company letterhead.

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"I SAW IT IN THE IRON AGE"

is a common phrase in the metalworking industry. Let the industry say it about your product.

VICKERS HYDRAULICS Helps Cut Costs at PACKARD . . . *on Wide Variety of Jobs in New V-8 Engine Plant*



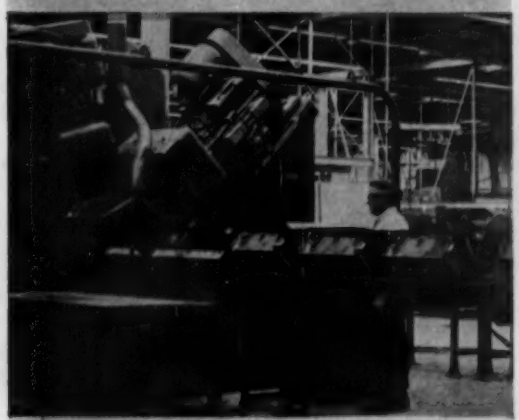
Kearney & Trecker machine for drilling and counterboring bearing caps. Note Vickers Traverse and Feed Cycle Control Panels visible on two heads; advantages include smooth and constant feed rates, easy adjustability, compactness and simplified installation.

Representative of the many and varied production machines equipped with Vickers Hydraulics in the new Packard V-8 Engine Plant at Utica, Michigan are those shown here. Among the advantages of Vickers Hydraulics are: (1) simplification of design, (2) adaptable to automation, (3) ease of providing interlocks and overload protection, (4) ease of maintenance with minimum down time. Equally important, Vickers Hydraulics gives you the benefits of a nation-wide and full-time field engineering and service organization.

The Vickers Application Engineer near you will be glad to show you the benefits you can obtain by using Vickers Hydraulics. Write for a copy of Bulletin 5002.



Michigan Drill Head Co. 8 station dial machine for connecting rods and caps. Vickers Hydraulic Power Units shown are complete hydraulic "packages" (pump, electric motor, valves, oil reservoir, filter, etc.) that simplify design, and save installation and maintenance costs.



Three Greenlee Transfer Machines in automatized cylinder block line use Vickers Hydraulics. Compact Vickers Traverse and Feed Cycle Control Panel shown on head assures smooth and constant feed rate regardless of fluctuations in tool resistance or changes in hydraulic pressure or volume.



Udylite Automatic Processing Machine saves space and assures more uniform quality by using Vickers Hydraulics to raise, lower and transfer cam shafts through cleaning, coating and rinsing baths in "Lubriting" process.

7109

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OVER 30 YEARS EXPERIENCE
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Low in Cost. Durable.
Easy to operate.
Table adjustable for straight or taper keyways
Three sizes. Keyways 1/16" up to 1".
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Rochester 8, N. Y.

ACKNOWLEDGMENT

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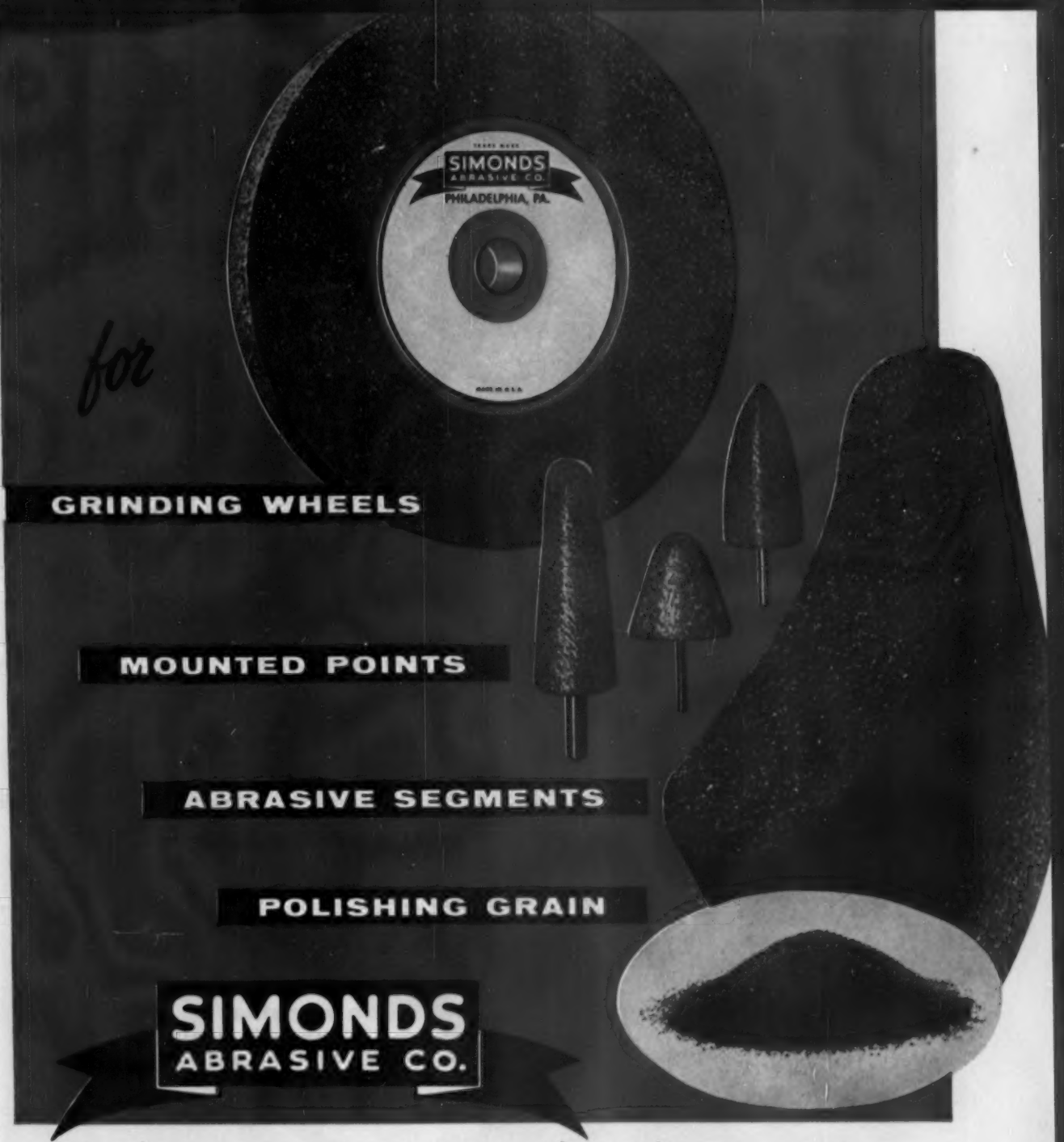
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Industry Capacity Listed in Directory

Mr. James M. Swank, secretary of the American Iron and Steel Association, has compiled, in the preface of his new directory just being published, the following interesting data relating to the number and capacity of the iron and steel works of this country.

Number of completed blast furnaces on March 1, 1880	697
Number of blast furnaces building on March 1, 1880—23 bituminous, 12 anthracite, 9 charcoal; total	44
Annual capacity of completed furnaces, in pig iron, net tons	6,500,000
Annual capacity of the 203 bituminous furnaces, net tons	2,825,000
Annual capacity of the 228 anthracite furnaces, net tons	2,600,000
Annual capacity of the 266 charcoal furnaces, net tons	1,075,000
Number of completed rolling mills and steel works on March 1, 1880	382
Number of rolling mills and steel works building March 1	10
Number of single puddling furnaces (a double furnace counting as two single ones)	4,467
Number of heating furnaces	2,419
Number of trains of rolls	1,397
Annual capacity of rolling mills in finished iron, net tons	4,000,000
Annual capacity of rail mills in heavy rails, net tons	2,150,000
Number of rolling mills having nail factories	73
Number of nail machines	4,152
Number of completed Bessemer steel works on March 1, 1880	11
Number of Bessemer converters—22 completed, 10 building	32
Annual capacity in ingots, net tons—completed converters, 1,250,000; new converters, 500,000; total	1,750,000
Number of completed open-hearth steel works on March 1	22
Number of open-hearth steel works building on March 1	3
Number of open-hearth furnaces—33 completed; 6 building	39
Annual capacity in ingots, net tons—completed furnaces, 225,000; new furnaces, 50,000; total	275,000
Number of completed crucible cast-steel works on March 1	35
Number of crucible cast-steel works building on March 1	3

Apr. 29, 1880



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What's *your* idea of service? Here's ours! A distributor network geared to help you over production crises as well as in your everyday grinding problems. Free consultation with our field engineers to search out new economies for you. Close teletype communication between our main plant and branches to expedite your orders. New mass production equipment to give you 3 to 4 weeks delivery on small diameter wheels . . . plus the extra product service inherent in Simonds manufacture. If this concept of service coincides with yours, get it by specifying Simonds Abrasive products.

EXTRA SAVINGS FROM YOUR SIMONDS DISTRIBUTOR
STOCK · SERVICE · KNOW-HOW

SIMONDS ABRASIVE COMPANY • PHILADELPHIA 37, PA.

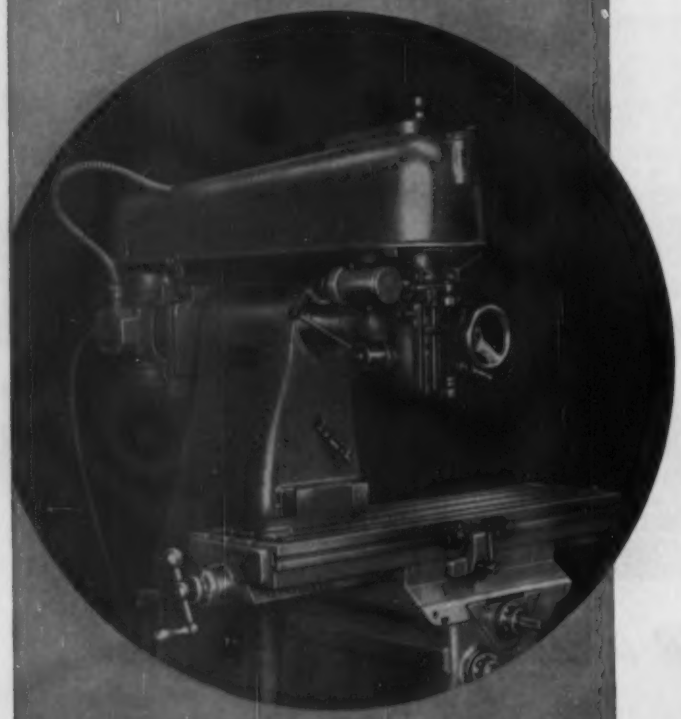
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Division of Simonds Saw and Steel Co., Fitchburg, Mass. • Other Simonds Companies: Simonds Steel Mills, Lockport, N. Y., Simonds Canada Saw Co., Ltd., Montreal, Quebec, Lion Grinding Wheels Div., Brockville, Ont. and Simonds Canada Abrasive Co., Ltd., Arvida, Quebec



does MORE work... MORE easily

new POWER FEED HEAD

U. S. Vertical Miller



Write for descriptive folder

Here's the new U. S. Vertical Miller with Power Feed Head – the head into which U. S. has built all the most wanted features without sacrificing traditional U. S. simplicity. Check its infinitely variable feed rate, its 800 pounds of down thrust on the quill, its supplemental hand feeds – it is the milling head that was designed to meet all shop needs.

Add to these the basic advantages of the U. S. Vertical Miller. You can easily see why it's the milling machine that "does more work more easily."

Detailed literature on request.
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32 Brotherton Road, Cincinnati 27, Ohio.

more versatile
Feed infinitely variable from .002" to .008" while in operation

greater capacity
5¾" power quill travel; 800 lb. down thrust

more convenient
Supplemental hand feeds

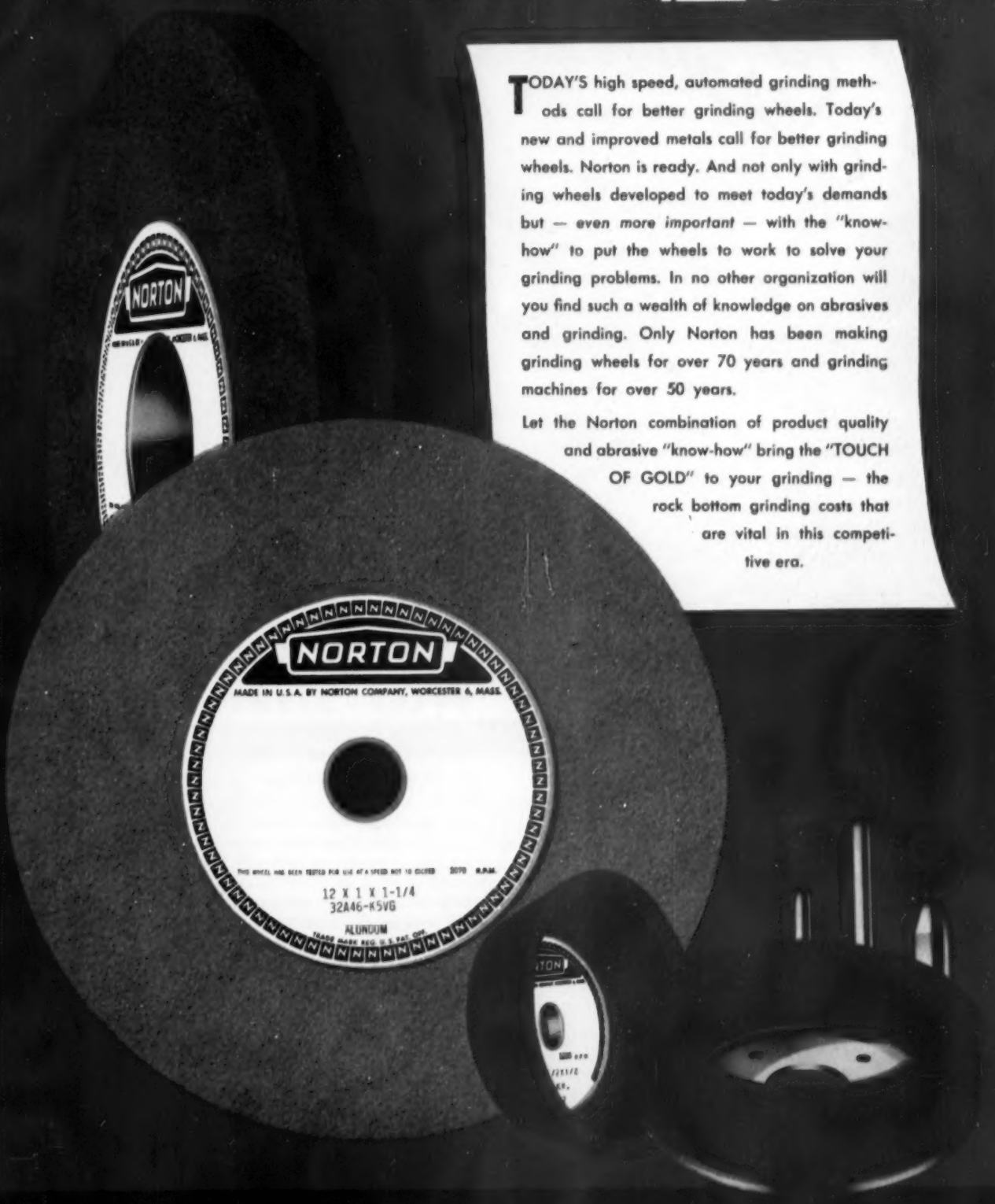
increased rigidity
Enclosed hard chrome plated quill with internal lock

THE U·S·Burke MACHINE TOOL DIVISION

NORTON KNOW-HOW can bring the "TOUCH OF GOLD" to your grinding

TODAY'S high speed, automated grinding methods call for better grinding wheels. Today's new and improved metals call for better grinding wheels. Norton is ready. And not only with grinding wheels developed to meet today's demands but — *even more important* — with the "know-how" to put the wheels to work to solve your grinding problems. In no other organization will you find such a wealth of knowledge on abrasives and grinding. Only Norton has been making grinding wheels for over 70 years and grinding machines for over 50 years.

Let the Norton combination of product quality and abrasive "know-how" bring the "TOUCH OF GOLD" to your grinding — the rock bottom grinding costs that are vital in this competitive era.



Making better products . . . to make your products better

Norton Service

can help you cut your grinding costs



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It means just the right wheel for each of your grinding jobs — wheels developed in the Norton research laboratories especially to meet today's exacting demands — it includes wheels of the exclusive 32 ALUNDUM abrasive and the new record-breaking G and K bonds. For you it means lower cost grinding. And if it's abrasive you use it also means the right type for each job — whether it's polishing, lapping, tumbling or pressure blasting.



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ABRASIVES

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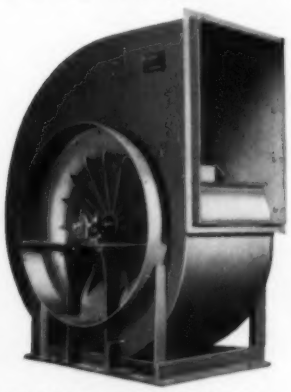
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WHEN *Iron Age* WAS 22



In 1877, this kind of horsepower was the order of the day in transporting "Buffalo" products to shipping points.

HERE'S HOW "Buffalo" FANS AND MACHINE TOOLS STARTED THEIR TRIPS TO SATISFIED USERS

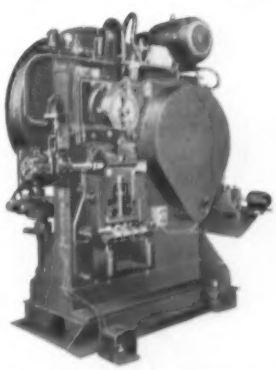


"Buffalo" Type BL Limit-Load Fan — the finest performer in our 78 years of building quality fans.

Even when this old picture was taken, "Buffalo" Fans and Machine Tools were respected by the country's fast-growing industry.

In the 78 years since, we've seen and made a lot of changes! Our constantly increasing know-how and wealth of first-hand experience have teamed up with the continually improving metallurgy and power sources to provide industry with the very latest and best products for air handling and metal-working through the years. Yes, there have been sweeping changes in "Buffalo" Fans and Machine Tools. Yet one thing we do not intend to change. It's the *"Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.* We guarantee you'll always get it, when you specify "Buffalo"!

The Machine Tool Show — Chicago, Illinois
Sept. 6-17, 1955



"Buffalo" Billet Shear, one of a wide line of "Buffalo" machine tools with an industry-wide reputation for quality, going back to 1877

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THE LONGEST RUN OF "FIRSTS" IN THE MACHINE TOOL INDUSTRY

1847 — A parent company of Jones & Lamson — Howe, Lawrence, Stone & Alvord of Windsor, Vermont — built the first standard turret lathe for general use.

1855 — Jones & Lamson introduced the first automatic-indexing turret on a turret lathe. (One of these early machines is still in working order — see it at the Machine Tool Show.)

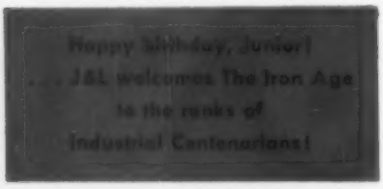
1874 — Henry D. Stone, of Jones & Lamson, patented the high turret lathe with power feed to the turret.

1891 — James Hartness designed the first flat turret lathe. Later, he offered to place the machine on trial with any responsible concern and accepted payment out of savings earned.*

1905 — Jones & Lamson introduced the first cross-sliding headstock for a turret lathe.

1935 — We were the first in the industry to redesign our turret lathes for carbide tooling. Extra power and rigidity were built in, to ensure maximum results from future carbide developments.

1945 — Jones & Lamson started research in Hi-Velocity Turning. Still in effect, this program is continuing to prove that doubling and tripling lathe spindle speeds and feeds can increase production, improve surface finishes and cut costs.





Culminating a

In the past 100 years, Jones & Lamson has witnessed and experienced a multitude of changes. In our own company, there has been a host of inventions, advances and developments, one after the other, and all pointed in the same direction — forward.

Now, J&L is preparing to unveil its latest developments, and a new line of machine tools which represents one of the greatest milestones in the history of machine tool engineering and manufacture. Be sure to see them — Jones & Lamson's crowning achievements — at the Machine Tool Show.

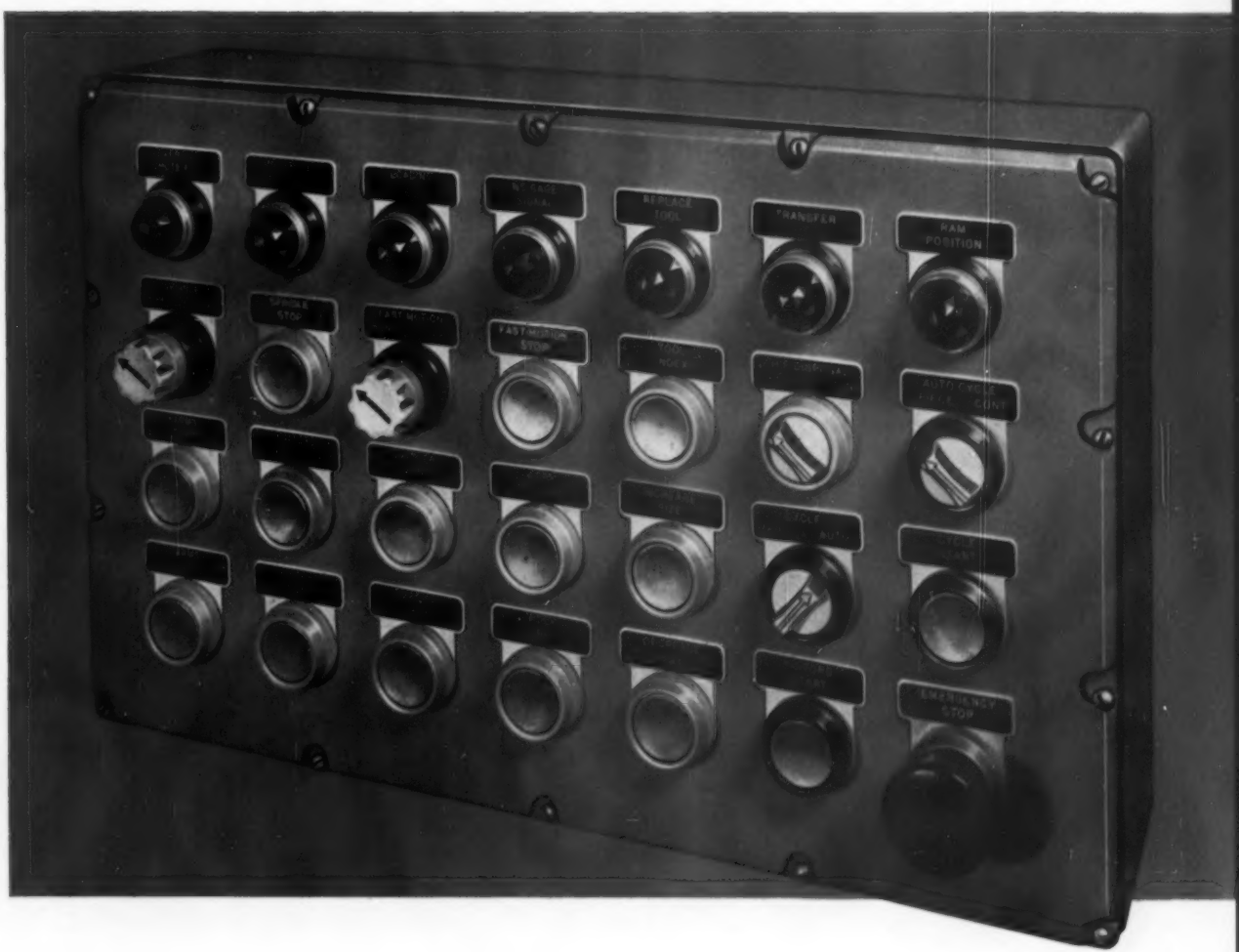
*Find out about J&L's *modern* Pay-From-Productivity plans. Write today for your free J&L Machine Tool Replacement Information Kit, which contains valuable information you can use in your business.



1955 — Jones & Lamson presents a tremendously significant new line of machine tool "firsts".
See it at the Machine Tool Show — Booth #1111.

Century of Progress...

THE MACHINE TOOL SHOW
CHICAGO, ILL.



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MACHINE TOOL DIVISION

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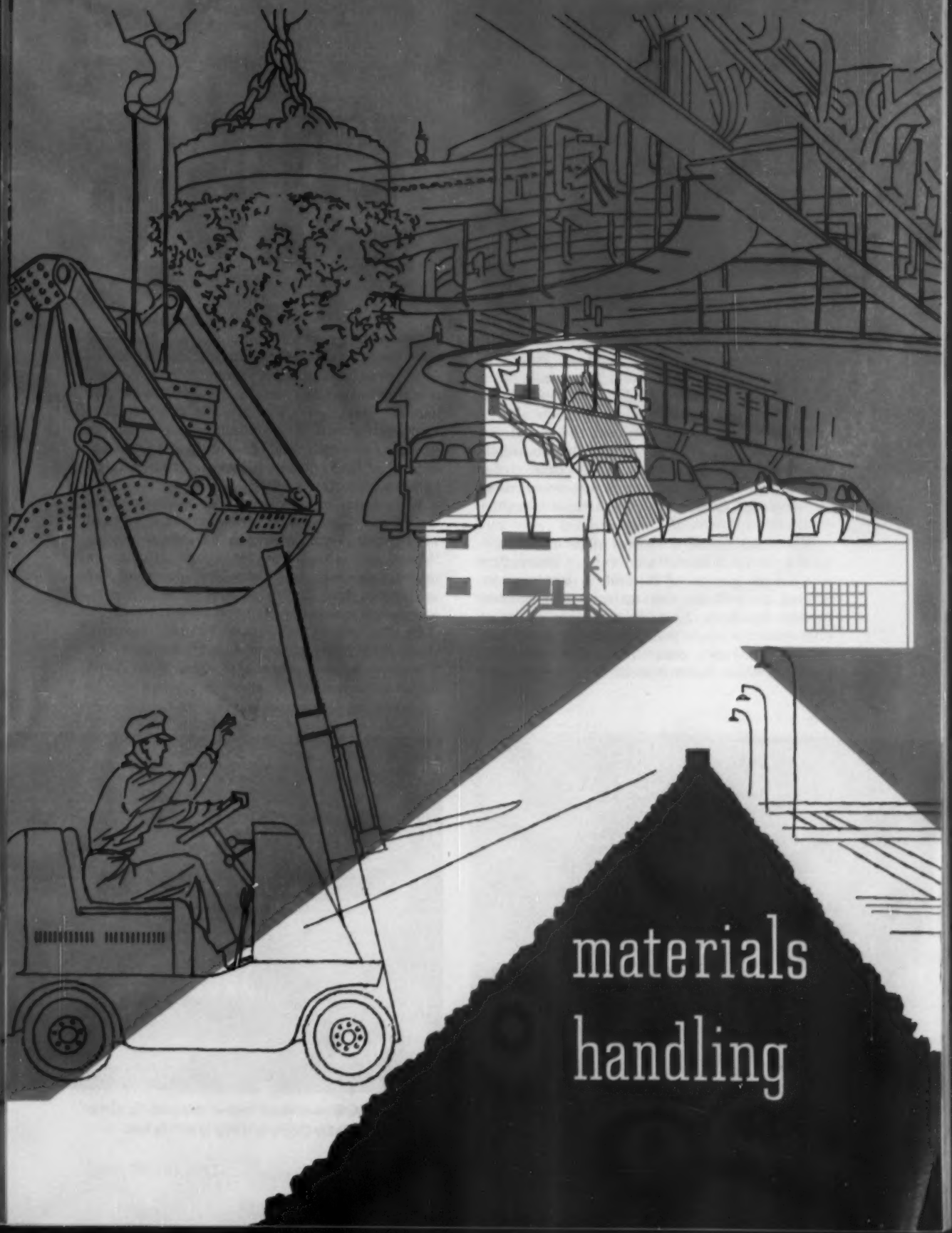
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100 YEARS OF METALWORKING



materials handling

MATERIALS HANDLING 1855 1955

MATERIALS handling methods are now scientifically applied in all stages of manufacturing from the handling of raw materials to the shipment of finished products.

But it was not until well past the initial impact of the industrial revolution that materials handling problems were definitely isolated for study. Prior to this, most effort was concentrated on developing fundamental manufacturing equipment and processes.

While bulk handling showed signs of advancement from the mid-1850's the turn of the century saw a wide growth of interest in bettering in-process as well as raw material and finished product handling. From this time on, hosts of improvements were made in the field of conveyors, lift trucks, cranes, hoists and other devices by which things are moved from place to place.

Belt conveyors for carrying bulk materials were among the earlist handling devices to receive close attention. Before 1850 they were made of leather and canvas and used mainly for handling grain, clay and crushed rock. Rubber as a belting material was first used with canvas in the mid-1860's and gained fast acceptance because of its flexibility, high abrasion resistance and good wearing qualities.

Wide belts for conveying heavy abrasive bulk materials attracted considerable attention around 1890 when Thomas Robins developed a wide rubber and canvas belt for Thomas Edison to use in processing iron ore. The success of the installation lead Robins to found his own company to sell conveyor belts to other ore processors.

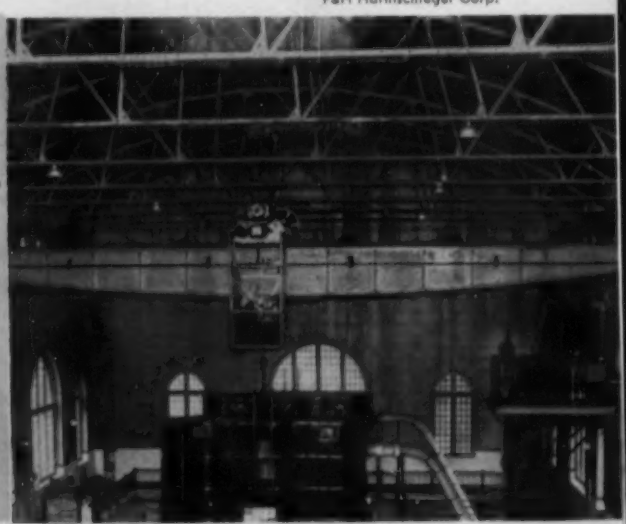
By the end of the decade the belt conveyor really took hold and soon found many new applications in coal, stone and other heavy, bulk materials industries.

Louden Machinery Co.



MONORAIL handling system in use at Kissel Kar automobile plant, Hartford, Wis., about 1918.

P&H Harnischfeger Corp.



SINGLE-HOOK overhead crane shipped to City of St. Louis Water Dept. in 1890 is still in use.

From that time on many improvements have been made in belt design, construction, materials and use. Latter day advances have seen the introduction of new synthetic, high strength fibers such as nylon, dacron, etc. The first use of neoprene in place of rubber for belting took place in 1937. The steel carcass belt was introduced in 1942.

Several dramatic long-haul belt conveyor applications have been made or proposed in recent years. Advanced thinking in the belt conveyor field is now concerned with the development of personnel carriers for industrial plants.

The first ten years of the twentieth century saw the beginnings of three types of conveyors widely used in industry today. These are gravity roller, monorail and trolley conveyors.

Monorail conveyors were first introduced in 1867 when William Louden obtained a patent on a hay carrier employing the principle. Other barn handling equipment items were later developed on the monorail idea but it was not until 1917 that the Louden Machinery Co. made its first industrial installation in a government munitions plant.

Monorails catch on

During the 1920's the demand for monorail installations for uninterrupted handling service, grew rapidly throughout industry. Along with fast spreading demand came improved designs, larger handling capacities and the development of self-propulsion units. Earl Bennington installed a motor and gear train on a monorail trolley and the Cleveland Electric Tramrail Co. was formed to produce equipment based on his ideas. Also during the mid-twenties American Monorail Co. began developments in this field.

All types of accessories have greatly increased the versatility of monorail handling in recent years. Transfer and switching devices have made overhead handling equipment extremely flexibile. Carrying capacities have been considerably increased. Present day developments have made possible the automatic dispatching of materials.

The first patent on a trolley chain conveyor was taken out by Christopher Levalley of the Chain Belt Co. in 1909. Although a milestone in trolley conveyors, lack of flexibility in making vertical turns, limited its application. About 1920 Palmer-Bee advanced trolley conveyor application by introducing double-angle track and a knuckle joint at the trolley to permit flexing. The double angle and double T-rail systems which followed are still in wide use.

Trolley chain conveyor systems similar to those in mass production industries today had their beginnings in the work of Jervis B. Webb who installed a system using Keystone drop-forged chain and load-carrying trolleys in Ford Motor Co.'s Toronto plant. The chain used was light in weight, with sufficient strength and good flexibility. The system could easily move materials of varying weights. Its low cost and ability to be used on I-beams hastened its acceptance.

Further improvements following in overhead chain conveyors were in the development of roller turns, taper and roller bearings, better drives, safety devices, power and free systems, overhead truck and underflow tow conveyors.

The first gravity roller conveyor contained rollers made of hard maple. It was introduced in 1901 by E. H. Ferguson and Bernard Alvey for handling brewery kegs and barrels. A year after founding the Alvey-Ferguson Co., Alvey patented the first gravity roller conveyor system with accessories.

Automatic dispatching begins

Another early entrant into this field was the Mathews Gravity Carrier Co. which developed a wheel conveyor using cast iron wheels with pin bearings. Realizing the limitations of wheel conveyors, R. P. Mathews and C. H. Listor, founders of the firm, soon introduced a gravity roller conveyor. The firm later became the Mathews Conveyor Co. and Standard Conveyor Co.

The efficiency and work-saving advantages of gravity roller conveyors for handling packaged materials were recognized quickly and improved designs and new applications grew fast.

Spiral roller conveyors were brought out in 1903 and ball bearings came into use in 1905. Power rollers and roller flight conveyors were introduced from 1910-1912. The late 1920's saw the beginnings of the automatic dispatching systems which are in common use today.

Overhead crane conveyors in the 1850's were crude, slow and of low capacity compared to present day standards. The first powered overhead crane was a 25-ton, steam-powered unit with a square shaft built by the Morgan Engineering Co. for the Dixon Mfg. Co.

The steam-powered crane soon was superseded by an electrically-powered unit built by

Baker-Raulang Co.



RAM TRUCK developed about 1920 started trend toward today's two-fork, cantilever design.

Morgan Engineering in 1881. In this 10-ton, one-motor crane, the long square shaft was eliminated. The motor, mounted on the bridge, took the place of a steam engine.

The first three-motor overhead crane, the forerunner of present day models, went into operation in 1888. A. P. Shaw, an employee of the then Edward P. Allis Co., rebuilt and redesigned a 10-ton rope-driven crane, using three independent reversible motors and no clutches and gearing. Soon after, Shaw went into partnership with Alonzo Pawling and H. Harnischfeger of Pawling & Harnischfeger. It was in the Harnischfeger shop that the third electric crane, a 40-ton, double trolley crane was built for the Union Pacific Railway in 1890. Shaw later settled in Muskegon, Mich., where the Shaw-Box Div. of Manning, Maxwell and Moore, Inc., is now located.

Crane designs advanced with the development of the steel industry. Without them steel industry operations would not be as we know them today. The first big steel plant to use electric cranes on a large scale was the Carnegie-Illinois Steel which bought 13, 10-ton cranes in 1893.

Since the advent of the modern three-motor electric crane era, many improvements and refinements have been made in overhead traveling cranes. Among these are better and more accessible designs, better lubricating systems, better motor operation control, better braking control and safety features.

Develop first industrial truck

More recent innovations include the use of worm gear drives, anti-friction bearings, welded joints, welded one piece trolleys and bridge and carriages, double-bridge drives, air conditioned cabs and welded girders.

Perhaps more than any other class of equipment, industrial trucks, particularly the fork lift variety, symbolize materials handling to the average person. While the industry has undergone steady growth and development since the early 1900's the staggering problem of moving mountains of materials during World War II did much to focus public attention on this area of materials handling.

In 1906 the first electric-powered industrial truck was developed by the Elwell-Parker Electric Co. This unit, used to handle baggage for the Pennsylvania R.R. was one of the early foundations on which the industry is built. Since then have come a myriad of advances in design, power units, handling mechanisms, steering and safety devices which defy accurate chronological classification.

Origin of the lift truck system using skids or pallets is generally attributed to Walter C. Steubing. The principle was first applied by Steubing in handling skids of printed material in 1905 when he proposed using legs on pallets and a truck mechanism which could be inserted between the pallet and the floor. About 1910 H. H. Cowan developed a hand platform lift truck. Later these separate complementary companies merged into the Steubing Cowan Co.



Elwell-Parker Electric Co.

LOW-LIFT truck handling pots in annealing furnace about 1915. Forks tilted backward to lift.

Many important advances, too numerous to detail, were made from 1910 to 1920. Some of the major ones include: the first multistroke high lift truck by Lewis-Shepard in 1915; Mercury Mfg. Co.'s gasoline tractor for industrial use in 1913; straddle carriers built by H. B. Ross about this time for carrying lumber; Automatic Transportation Co.'s introduction of an electric battery-driven tractor to pull small hopper cars; a fork truck with true lift and tilt by Elwell-Parker in 1920; and the ram truck by Baker-Raulang Co. about 1920.

Improvements continued through the 1920's to the present. Yale & Towne offered attachments about 1924; power-operated crane trucks were put out by Baker-Raulang in 1921; first production line gas-powered fork trucks were built by Clark Equipment at the end of the decade.

Modern fork truck evolves

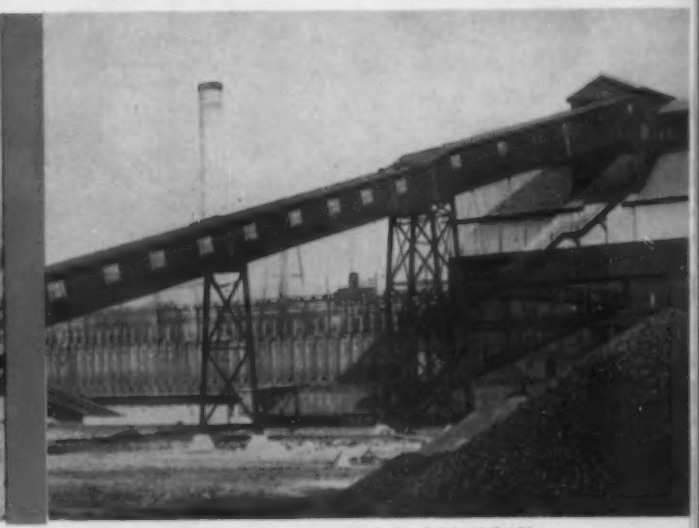
Later developments have seen the evolution of the first fork truck to combine hydraulic lifting, center control, front and rear wheel steering by Towmotor Corp. in 1933; use of pneumatic tires on Hyster straddle carriers and other equipment in the late 1930's; Lift Trucks, Inc.'s (under Walter Steubing), motorized hand lift truck in 1936; first hand pallet truck designed and built by the Lyon Iron Works (now Raymond Corp.) in 1937 and in 1941 compact Lewis-Shepard fork lift truck to operate in aisles 1 to 3 in. narrower than other trucks could at that time.

While the enumeration of these advances cannot be all-inclusive, it does show the progess made by the industrial truck industry in a very short period. As industry continues to realize the advantages of mechanized over manual handling the industrial truck field will keep pace with it.



Hewitt-Robins Inc.

ROBINS AND EDISON inspect tipped shovel at ore mine where first belt conveyor was installed.



Manhattan Rubber Mfg. Div.

CONVEYOR belt installed in 1926 for handling crushed coal at steel company byproduct plant.

Although William S. Otis invented the power shovel around 1830, this part of the materials handling industry did not really get underway until the 1880's and 1890's when such companies as The Vulcan Steam Shovel Co., The Marion Steam Shovel Co., and The Bucyrus Co. were building shovels based on Otis principles.

The early 1900's saw the introduction of revolving shovels, crawler mountings and improved friction clutches capable of handling heavier loads. During the 1920's Bucyrus-Erie introduced a diesel powered shovel and caterpillar mountings. Diesel use grew along with gasoline-powered units during the thirties which also saw the growth of power cranes of large capacity, mobility and operating efficiency which are the forerunner of today's models.

Less dramatic than other classes of materials handling equipment but fundamentally just as important to the development of good materials handling has been the steady improvement in such items as casters, wire ropes, hoists and slings.

Improvements in design of casters can be traced from 3-in. cast iron casters in 1900 to the present types which will absorb and withstand shock of both horizontal and vertical impacts.

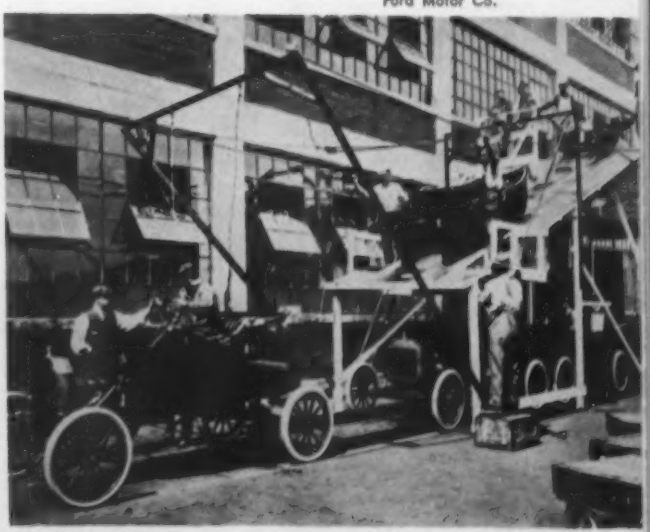
Wire rope made of soft iron is said to have originated in Germany in 1840. More progress was made in the latter part of the nineteenth century with the development of steel ropes. By the start of the twentieth century more attention was paid to selecting wire rope and this trend has continued to the present where wire rope is designed to meet specific needs.

Improvements in hoist design and function have been steadily made since 1855. Included among the major milestones along the way are: the first Yale differential pulley block invented by Weston in 1875; the motorized hoist by Alfred Box about 1890; powered-spur gear hoists built by Sprague Electric (now part of GE) about 1900; and low headroom units developed by Haldy of Yale & Towne about the same time.

From 1900 hoists steadily improved in the direction of compactness, less weight and greater carrying capacity. Advances were made in motors, controls and braking devices.

Materials handling, following on the heels of the industrial revolution, has made rapid progress in a short period of time. It is now being applied intensively in all stages of manufacturing. So much so, that many experts now feel that handling concepts should be given first consideration in the design of a modern manufacturing plant.

Ford Motor Co.



FORERUNNER of present day assembly line is this outdoor setup at Ford Motor Co. in 1913.



Hewitt-Robins Inc.

CONVEYOR system
at Baltimore railroad pier
handles 3000 tons
of iron ore per hour.

CAR BODIES are
automatically transferred
in assembly plant
by nearly 8 miles of conveyors.

MATERIALS HANDLING...

DeSoto Div., Chrysler Corp.



the present

TIME will prove that the early 1950's were one of the most significant in industrial history. Plants built during this time, although they included the latest and best in production equipment, differed from immediate postwar plants most significantly in their aggressive application of new material handling concepts. "Our new plants actually are not built around new processing systems, but around new handling systems," said the plant engineer for a major corporation.

"Automation," a word coined to describe automatic handling of work in progress, spread rapidly throughout the metal working industry. It leaped into other industries and into other functions. A hundred definitions were applied: automation meant "automatic work feeding" . . . "automatic control" . . . "automatic inspection" . . . "automatic production." And, enthusiasts insisted that it wasn't really simon-pure automation unless it included self-regulation (feedback).

Regardless of how the enthusiasts chose to define it, automation became the synonym for advanced mechanization from about 1952 to date. As industry actually uses the word today, it describes no accepted standard or minimum amount of automaticity. Rather, it reflects an organized, company-wide effort to achieve new levels of mechanization embodying a large amount of automatic operation. Efforts to mechanize are thus much more aggressively and thoroughly coordinated from product designer to shipping dock, and from vendor to customer.

Automotive engine plants have been widely heralded as among the most advanced metal working plants of the day. Embodying the latest materials handling ideas, they include these things:

1. "Automation equipment" to connect the transfer machines that machine the cylinder block castings. This automation equipment consists of several types of shuttle bars, either hydraulically or pneumatically actuated, turnover and rollover devices. All are interlocked electrically so that the cylinder block plant has become, in effect, one large "transfer" machine.

A block is placed into the first conventional transfer machine in the line, passed through its successive stations, then is seized by the automation equipment and automatically moved to whichever of the next transfer machines is open for work. This continues throughout the entire block finishing operation. The automation devices "decide" where the block should go; they orient it; and they move it, upon demand, to the available production machine.

2. Power and free conveyorization of the engine assembly, paint, bake, test, storage, and shipping dock cycles. Through this old device, which is just now being rediscovered by industry, automatic handling on a continuous basis is combined with complete selectivity and automatic removal or dispatch of any engine to or from

the line. This combination makes it practical to apply continuous flow to a sequence of operations even though they have different cycle times and individual product delays (such as testing).

Power and free is the heart of the assembly system in the newest V-8 engine plants, in several body assembly lines, in appliance manufacturing, in automatic bumper plating machines, as well as industries outside the metalworking field. Undoubtedly, this device will continue to expand in application wherever continuous flow, flexibility, and selectivity are required. It is among the most important new conveyorization techniques in the metal fabrication field.

3. Automatic work feeding devices of a wide variety. Mechanical arms or hands that feed large metal sheets into presses are being applied on an increasing scale. They have been engineered to include at least six types of gripping heads so that they can handle sheets of various finishes, contours or edge shapes. The automotive and appliance industries are making extensive use of these devices. In a typical example four men and five presses with mechanical hands are turning out twice the output of twenty-five men manning the same presses. Safety and backache reduction are marvelously improved.



Tommotor Corp.

Add work-feeding devices

Most moderate and high volume metalworking plants have added work feeding devices to lathes, grinders, milling machines, presses, drills, etc. These automation devices are of many kinds:

(a) Arms that seize a part from a feeding rack, place it in the work holding element of the production machine, then remove and dispose of it after processing;

(b) Hopper feeding devices that orient the parts, then feed them by chain conveyor or gravity in a continuous stream into the processing machine;

(c) Vibratory feeders for tiny parts. These devices feed and orient masses of little items—clips, eyelets, brackets, rivets, etc.—in the manufacture and assembly of electrical equipment and other smallish mechanisms;

(d) Pneumatic dispatch and discharge of parts is becoming more common, too.

4. Chip removal. No high or medium volume plant could be called "modern" today unless it provided for the automatic removal of chips generated in substantial quantity. The larger installations use conveyor systems from each machine, feeding a master conveyor under the floor. At the very least, conveyorized discharge from machine tool into adjacent collection bin boxes (with fork truck or crane removal) is adopted.

5. Semi and full automatic inspection. In the up-to-date metalworking plant, we are beginning to see significant gains in automating inspection:

(a) It has become standard practice in top-



notch plants to take the handling out of inspection. Work is moved to, through and from the inspection station with little or no manual effort. On small parts, belt conveyors often perform this function. For larger parts, an appropriate form of conveyor is used including roller, trolley and power and free.

(b) Inspector labor is often reduced by a positioning lift or hoisting arrangement at the inspection station. These devices are incorporated in such a way that the part moves in front of the inspector in a completely convenient manner, rather than requiring him to manipulate, stoop, squat and maneuver around the part.

(c) Inspection itself has been given new impetus under automation: Measurement often is by a mechanical probe, or by hydraulic or pneumatic pressure. These devices actuate an electrical or electronic circuit to pass or reject a part; A great many machine tools have been equipped with signalling circuits that flash a light and shut down the machine when an offsize dimension is encountered; A few—very few —machine tools have been equipped with control devices that measure the dimension being created and modify the action of the tool mechanism accordingly. This is the much acclaimed "feedback" idea; Weight-machining is no longer novel. Many manufacturers are also applying this concept in the dynamic balancing of rotating parts including crankshafts and flywheels.

6. Automatic assembly is barely in its infancy. Yet a number of high volume operations in the automotive and appliance parts industry, the lamp and the electrical and electronic equipment field have been automatized by arranging a sequence of production, assembly and inspection operations around a rotary indexing table or a straight-line machine.

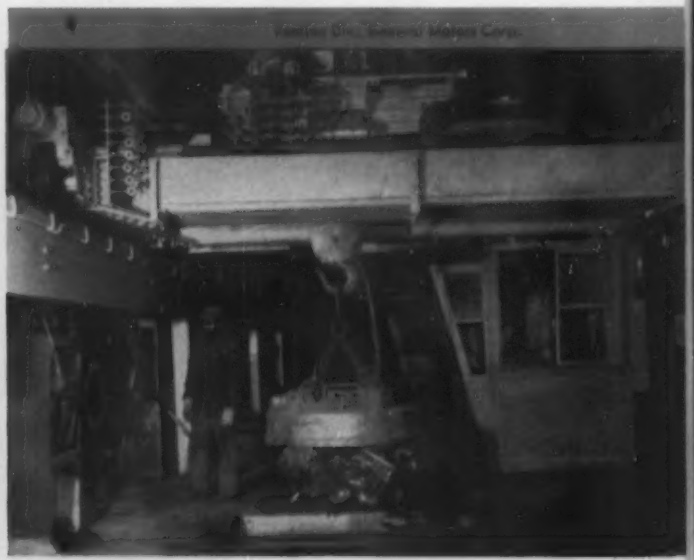
1 UNIT LOADS of irregularly-shaped axle housings are moved efficiently by fork lift truck.

2 HEAVY WELDMENTS are lifted easily by this late-type, general purpose yard crane.

3 HYDRAULIC hoist truck has simple, detachable box for quick and efficient scrap hauling.

4 ELECTROMAGNET on crane dumps scrap bales into hopper for transfer to cupola charging floor.





7. Conveyorized feed from receiving to production line is growing, and conveyorized banks of material between production operations is common.

The developments mentioned largely reflect efforts to achieve continuous flow. As such they are confined to medium and large volume production items. In more limited production other tremendously important and fascinating changes are under way.

Containers now "engineered"

Although it is far less dramatic than the conveyorization of industry, the container now is fully as important because of the growth of the unit load concept.

This is the age of the engineered container. Today containers are being designed as part of an overall production system. They are filled from the top, or side; discharged from top, side or bottom as required. They are designed to fit into, on or over production equipment, work stations, common carriers and to work with special handling devices. They have been made collapsible to save space and return-shipping costs; watertight for protection of the contents; and have been given hopper type bottoms to facilitate valve controlled discharge of pre-weighed contents.

In its simplest essence, the unit load is no longer a box so large that we need a fork truck to move it. Rather, it is a load of a size and in a container planned to facilitate loading, handling, shipping, discharge and storage full or empty.

Other significant equipment developments are numerous. Fork trucks have been refined to offer faster operation, easier maintenance and smoother controls. A number of versions of gas-electric, hydraulic coupling and torque converter drives have been introduced to minimize the maintenance cost on gas trucks and to provide smoother, faster operation. Power steering has been added to larger trucks with good results.

No user of fork trucks should overlook the growing use of L-P gas as a power source. One aircraft company, for instance, has converted 120 vehicles to this fuel; and many others are experimenting. Indications are that L-P gas reduces engine wear, so that two to five times the usual engine life between overhauls is claimed. Depending on location, fuel costs may be cut. Repairs and oil changes are also reduced by this clean-burning fuel. This may well be the important truck development of the mid-fifties.

In the fork truck field an important "new" truck has been the straddle-type fork truck. Pioneered in 1951 it has grown in use and application until almost all industrial truck manufacturers now offer it. Its principal advantage is that it enables the user to operate in aisles as narrow as six feet. This can mean a tremendous gain in storage space, so the truck has been popular for the warehousing of loads of 2000 to 3000 lb.

Combine fork and motor truck

The straddle carrier, which originated in the lumber industry, is coming into its own. This vehicle is providing improvement in billet and bar stock handling and storage and in the servicing of rolling mills in steel plants.

Straddle carriers can pick up loads up to 22 tons in 15 seconds, carry them at 25 mph on roads (or less on rough terrain) and unload in 3 seconds! All this is done by just one man—the driver. Carriers are designed for any "package size." One steel company recently purchased one to carry 120-in. wide plates. Special carriers, designed for heavy-duty steel handling service, are now standard. Steel plants, heavy machinery fabricators, aircraft and shipbuilding firms are applying them.

Another unit which is a combination of fork truck and motor truck has shown good performance in yard and storage handling of different steel products.

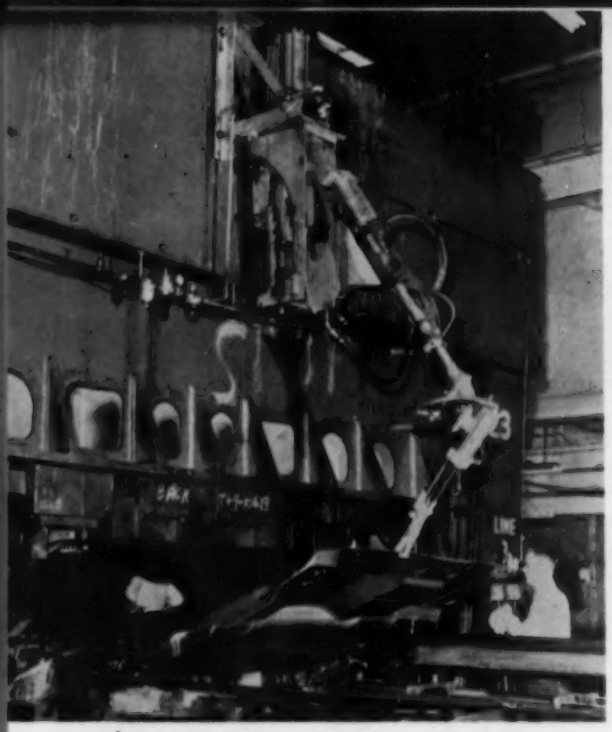
Communication systems for industrial vehicles (and some cranes) is an important present-day materials handling development. A study of some 25 installations shows productivity increases of from 10 to 200 pct through the use of two-way radio.

Industrial television is proving very useful in the remote control of the pouring of steel, feeding material into furnaces and watching dangerous operations from a safe distance.

Crane and hoist controls have been improved to provide superb control of hoisting or lowering throughout the full range of capacity and speed. One new development—the stacker crane—is spreading rapidly. It is largely a storage tool. This "fork truck hung from the ceiling" permits high stacking and narrow aisle operation. It is

5 The Raymond Corp.





6 Sahlin Engineering Co.

5 FORK TRUCKS, left, can operate in aisles as narrow as 6 ft, reduce storage space needs.

6 MECHANICAL HAND lifts automobile floor pan from stamping press, speeds operation.

7 STRADDLE CARRIER transports 27,000 lb load of 15 in. OD pipe over highway at a fast pace.

8 COLLAPSIBLE wire mesh container permits easy access to forgings, lowers operator fatigue.

unusually well adapted to handling long shapes.

Two developments in the handling of coal deserve attention. The first is the growth of coal augering. The coal auger is nothing more than a giant version of a wood auger. Up to 5 ft in diam, it is being used to drill into strip mine areas beyond the economical stripping limit.

The auger is mounted horizontally and discharges into the boat of a bucket elevator, or portable conveyor which loads a truck. A crew of 3 to 5 men can mine coal at 400 to 700 tons per day.

Mining by remote control

Continuous remote controlled mining is another noteworthy development in coal. Several variations exist. They are largely based on the concept of a vehicle looking something like a small tractor and mounting a head that bites its way into the coal across the width and height of the vehicle. Production is at the rate of 700 to 800 tons per shift, with a crew of 7 to 10 men.

In the last year, two remarkable ore loading installations were made: the Orinoco loading station in Venezuela and the Labrador iron ore shipping point at Seven Islands, Quebec. Ship-loading is done at a rate of 6000 tons per hr and 5000 tons per hr respectively. Thus the largest ships can be loaded in 4 to 5 hr.

Cross country belt conveyors—above and below ground—continue to grow in numbers and length. The Ohio Power Co. recently installed a 4½-mile belt that takes coal from strip mine to steam electric generating plant. This is the longest permanent open-air overland belt conveyor ever built. It climbs and descends two hills that are almost 300 ft above the valleys. It takes 39 min. to make this trip, crossing two roads and a river on its way.





MATERIALS HANDLING

the future

DRAMATIC and exciting developments are on the material handling horizon. Some of these will be so startling as to command the attention of the entire public; others are less evident, but even more significant. Here are some outstanding eye-catchers, built around the concept of continuous flow:

1. Riverlake Belt Conveyor—Whether or not this project goes through, it has been a magnificent concept. There is not a doubt that this 108-mile belt conveyor is mechanically practical. Research and development work done in the last six years has resulted in improvements that considerably raise the anticipated performance of the system. The fund of knowledge accumulated is helping to make other large scale belt conveying projects practical.

It has been suggested, for instance, that a 40-mile belt conveyor be constructed across the upper Michigan peninsula to bypass the Soo locks should they be damaged by enemy attack.

Certainly we will see more and more belt conveyors on hauls measured in miles, rather than feet. The belt conveyor literally is becoming our newest common carrier, and not solely dedicated to inert materials, either.

2. Passenger Conveyors—Far more evident to all of us will be the spreading use of conveyors to move people. The material handling industry is at last proving to designers, architects and city planners that people, too, are a material handling problem. Where volume is high and paths are fixed, the conveyor is the economical and efficient solution.

The next ten years may see the belt passenger conveyor and the car passenger conveyor used on a wide scale to expedite traffic at rail and bus terminals, airports, shopping centers, factories, public buildings and passageways. The belt conveyor is certain to be the next significant step in common carrier development.

Not so dramatic to the eye, but quite likely and useful, is the pumping of coal in the form of slurry. Tests by Pittsburgh Consolidation Coal Co. have proven this to be practical where water supply and economic factors permit its use. They expect that the next five years will see a number of cross country pipelines moving several million tons of coal a year.

Unit load systems are on the verge of a tremendously important gain. This is the growth of containerization—systems of giant packages



handled by fork and straddle truck. Earlier this year one company demonstrated a container system in which container, common carrier and handling devices are integrated. The system consists of huge containers (or small trailer bodies) that can be picked up by fork or straddle carrier, placed on a truck bed or railroad flat car, and automatically locked into place by the action of the handling device and special lock on the carrier. In effect, one man loads and secures 10 tons on a carrier in 1 or 2 min. Three containers (each 1,000 cu ft, 10-ton capacity) fit on a flat car, two on a 35-ft truck trailer.

What new levels of mechanization will appear in the years ahead? Clearly, automation will spread in ever-widening circles through every sort of industry. We can expect to see:

1. Compounding of processing machines—More new machines will be built to incorporate a series of production operations formerly done by individual machines. Whether this will take the form of special machines or whether these machines will be built up from standard heads and drives is anybody's guess. Standardization appears to be a better idea provided the desired functions can be obtained.

2. Integration—by using conventional handling equipment to link adjacent production operations including receiving, shipping and storage. This trend is already heavily in evidence, and we will see that the conveyor in its various forms will gradually become the principal machine in the factory. It will not only join production operations but will start a production cycle, fix cycle times and terminate operations. The production machines will be built around it and on it, rather than vice versa.

3. Control and instrumentation—Instruments will be more widely used to measure temperatures, check things like physical characteristics, dimensions, positions, levels of material, weight, form, etc., and record information on an ever-increasing scale. These sensings, moreover, will be transmitted to a central point where they will be under the control of a single individual and perhaps in some cases under some sort of a master programming device or computer. Centralization of control will reduce the manual effort needed to run the production operation and greatly improve quality and uniformity of product.

In many cases individual characteristics will be so measured, and then the information will be fed back into the production machine itself so that it will modify its performance. This feedback concept will be used much more.

4. The automation of assembly operations—It is clear that almost any piece of material can be made automatically, if volume requirements are high enough. The real test of production skill and the ultimate in economical manufacturing will be to assemble automatically as well. The electronics industry has made important strides in the use of printed circuits with automatic assembly of components into a prepunched chassis. It is also developing ways to

assemble a variety of resistors, condensers, etc., out of a few standard components.

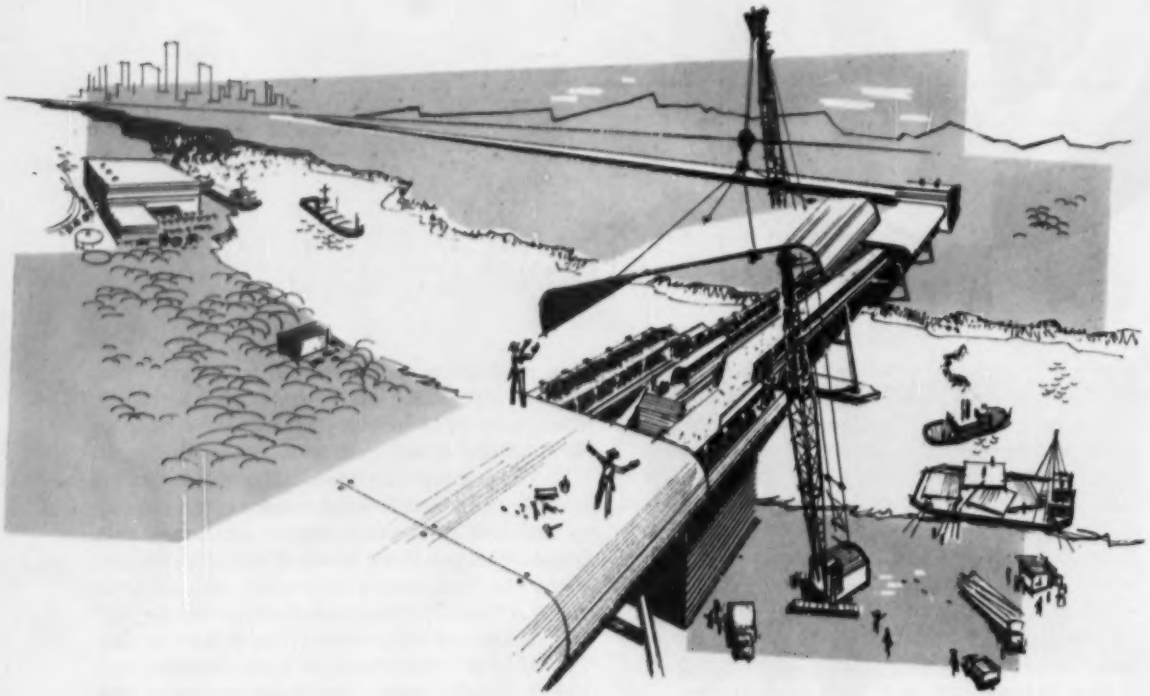
The same concept—the automatic assembly of many products from relatively few standard parts—is being applied in the manufacture of electrical equipment. Does this mean that we will have two kinds of factories tomorrow? Will we manufacture parts automatically and assemble only to order? Indications are that this may be necessary in the multi-products plant. Certainly we will see new stress on automatically assembling and testing products.

5. Program control of machinery—By means of tape, punched cards and similar devices, we will direct machines to perform a series of operations. The general purpose machine, program controlled, may prove to be the most economical way to automate many operations.

6. Producibility—None of these things can be done without extensive redesign of the product. Tomorrow the designer will have to count producibility as having equal or even greater weight than mechanical performance.

Most important of all, what will automation mean to management? It is clear that whether by small islands of automation, or by revolutionary overall changes in manufacturing technique, the factory is becoming one master machine. To the extent that this is so, management is assuming new risks. It is gaining low-cost production, improved quality, reduction in lead time, lower inventory, easier working conditions and similar advantages in exchange for flexibility and, usually, a somewhat higher investment. How serious this risk becomes will vary with the industry and with management's astuteness at designing a mechanical unit that is in harmony with its environment.

Tomorrow's management will have to operate more than ever by plan, since it will be committed to a specific character of production as never before. This means even greater management teamwork. Management must become a sensitive instrument to measure the environment surrounding the production operation. It will be up to management to redirect the company's production effort and techniques as external developments suggest a change.



ORE AND COAL move on elevated belt conveyor in artist's sketch based on proposed Riverlake belt conveyor. Metal sheathing which completely encloses belts in Riverlake design is shown removed here for maintenance. Coal, left, moves from the Pennsylvania and West Virginia coal fields to industries in northern Ohio. Iron ore, right, moves from Lake vessels to inland waterways where it is loaded for shipment to mills. While the Riverlake proposal has hit tough sledding in the Ohio legislature, most materials handling men agree it is sound, economical—predict that technique will eventually be applied—either in Ohio or elsewhere.

Look overhead..see "NORTHERN"



Production Tooling for Production Materials Handling

Mechanized production processing — automation — with its hooking up of special purpose units, devices and controls designed to increase productivity — must be increasingly dependent on special purpose production tooling of all kinds—including overhead materials handling equipment.

NORTHERN OVERHEAD ELECTRIC TRAVELING CRANES—for wide spans—capacities up to 150 tons — when correctly custom-built for special purpose use — can quickly earn their cost in only a few years when they are fully integrated in your production planning.

Let us send you Technical Bulletin W-101.

NORTHERN CRANES—HOISTS—TRAVELATORS

NORTHERN ENGINEERING WORKS

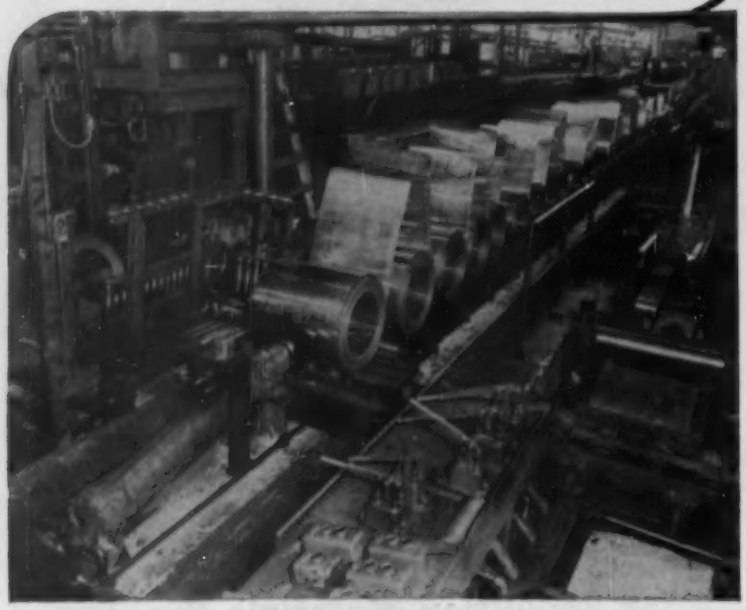
210 CHENE ST. • DETROIT 7, MICH.

Automation

WE'VE WORKED TOWARD IT

FOR 50 YEARS AND CALLED IT

CONTINUOUS FLOW



Typical Mathews conveyer system made up of power conveyers and special conveying machinery in modern brass mill.

Mathews conveyers have for 50 years been helping manufacturers progress toward automation by handling materials to and from processing machines with a minimum of manual effort. Today, in almost every industry in plants throughout the United States and Canada, Mathews mechanized handling is at work creating a smooth, continuous flow of materials.

For information, write to the Mathews field office or plant nearest you. Ask for Catalog 853-R.

50th Anniversary MATHEWS CONVEYERS 1905-1955

MATHEWS CONVEYER COMPANY
GENERAL OFFICES . . . . ELLWOOD CITY, PENNSYLVANIA
PACIFIC COAST DIV. MATHEWS CONVEYER COMPANY WEST COAST
SAN CARLOS, CALIFORNIA
CANADIAN DIVISION . . MATHEWS CONVEYER COMPANY, LTD.
PORT HOPE, ONTARIO

Engineering Offices or Sales Agencies in Principal American and Canadian Cities

MATHEWS

Quotes: 1855 — 1955

Abstracts from past issues of THE IRON AGE, *selected for their flavor, and with some regard for whimsy:*

The Channel Tunnel

It seems that the proposition to tunnel under the English Channel is not to end in talk after all. The company registered in London on the 15th ult., is about to excavate a trial shaft and driftway on the English side and it would seem if found practicable to push the work on until it reaches the shores of France.

Feb. 15, 1872

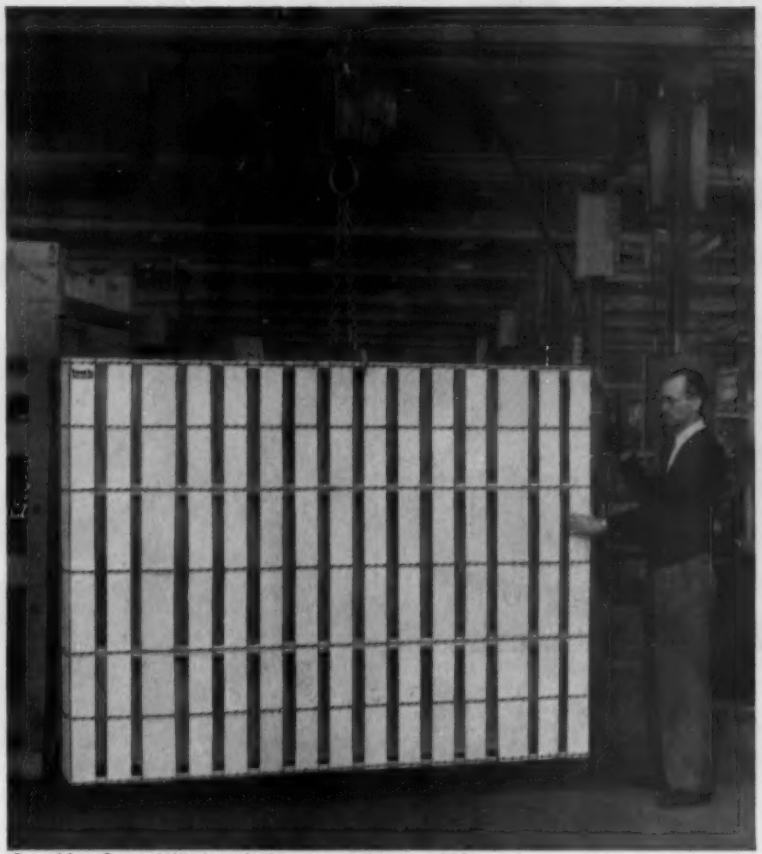
Come to Full Stop

A recent law, passed by the legislature of Iowa, provides, "That trains shall come to a full stop on approaching crossings, under a penalty of $500 for non observance, half of which sum goes to the informer. And in case that life or property should be destroyed by violation of the act, the penalty is double the value of the property so destroyed, and for every life lost, from $10,000 to $50,000."

June 18, 1856

Favor Tunnels for Future Traffic

The Studies of the Department of Bridges and of the Rapid Transit Commission as to connections for or with the bridges over the East River, New York have been devoted almost exclusively to elevated or train service. It should be remembered that the number of great bridges over the river can never be very large; the excessive



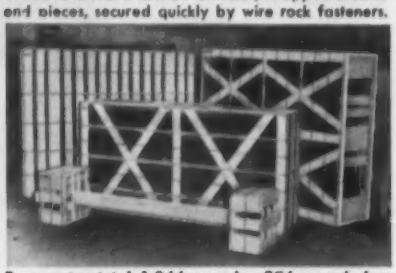
One of four General Wirebounds, this one, containing two 100-pound glazed door wings, is ready for shipment from the Evansville, Indiana, plant of International Steel, largest revolving door maker.



Here are curved enclosure walls. End pieces bolt on, prevent shifting in transit



Wirebound mat is laid out on floor, wrapped around end pieces, secured quickly by wire rock fasteners.



Four crates total 1,044 pounds—396 pounds less than before, take only half the time to pack.

Revolving door costs turned sharply down by General-Engineered Wirebounds

Shipping a revolving door means packing heavy, costly precision parts—a round ceiling piece, curved enclosing wall, glazed door wings, and an eight-foot shaft with large bearings at each end.

International Steel Co., Evansville, Indiana—the leading manufacturer of revolving doors—ships many per year, is keenly cost conscious. General Box engineers, working with International's Manager of Shipping, recently came up with wirebounds that cut shipping weight by 396 pounds and cut packing time in half, compared with the custom-built nailed crates formerly used.

Total savings from use of the new containers are expected to amount to at least $10,000 a year. As International's management is well aware, it would take a lot of sales to boost profits that much.

General has the testing facilities and the experience to help your company make this kind of progress, too. And it costs nothing to find out what the possibilities are. Just let us know where you are and what you ship. We'll send a man. And ask for your free copy of illustrated booklet, "The General Box."

Factories: Cincinnati; Denville, N. J.; East St. Louis; Detroit; Kansas City; Louisville; Milwaukee; Sheboygan; Winchendon, Mass.; General Box Company of Mississippi, Meridian, Miss.; Continental Box Company, Inc., Houston.

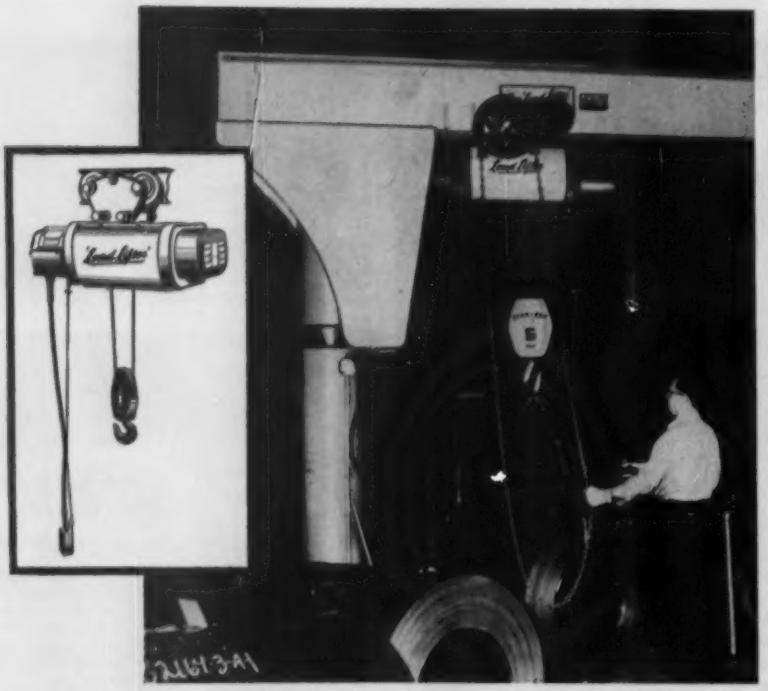
Engineered Containers for Every Shipping Need

• Wirebound Crates and Boxes • Generalift Pallet Boxes • Corrugated Fiber Boxes • Cleated Corrugated and Watkins-Type Boxes • Stitched Panel Crates • All-bound Boxes

General Box

1829 Miner Street, Des Plaines, Ill.

★ ★ ★ ★ ★



WANT LOWER COSTS? THEN USE THIS HOIST!

Step up load handling speed in your plant and save money doing it. Put the Series "700" 'Load Lifter' Electric Hoist to work. It shortens hoisting time—lifts a 1-ton load a foot in only 2 seconds! You get more lifts per hour.

The Series "700" 'Load Lifter' is a push-button work-saver, safety-engineered to protect man, load and hoist. Only 24 volts at the pendant control! The powerful load and motor brakes are synchronized; each alone can pull the full load. Steel suspension and overcapacity load hook, plus preformed nonrotating wire rope, provide super-strength.

The Series "700" 'Load Lifter' has few parts—trouble-free performance assured! There's extra durability in the heat-treated helical gearing; extra-smooth operation because ball bearings are used throughout. Capacities from ½ ton up. Single and two-speed control and all types of suspension available.

Let the nearby "Shaw-Box" Distributor show how this rugged hoist can cut your load handling costs. Or write direct for Bulletin 410.

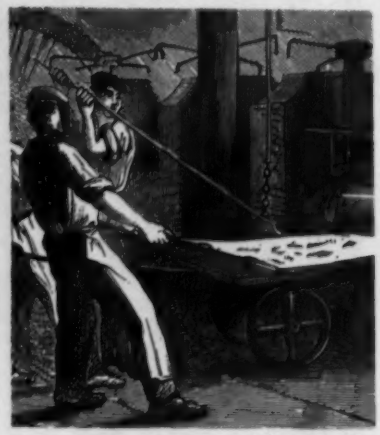
'Load Lifter' ® ELECTRIC HOISTS

MANNING, MAXWELL & MOORE, INC.
MUSKEGON, MICHIGAN

Builders of "Shaw-Box" and 'Load Lifter' Cranes, 'Budgit' and 'Load Lifter' Hoists and other lifting specialties. Makers of 'Ashcroft' Gauges, 'Hancock' Valves, 'Consolidated' Safety and Relief Valves, 'American' and 'American-Microsen' Industrial Instruments, and Aircraft Products.

cost and the vast areas of real estate taken from private utilities and from the assessment rolls dictate that the number of such bridges shall not be excessive. Tunnels can be built quicker and cheaper than bridges and are the normal agencies for the passage of subways across the river.

Sept. 14, 1905



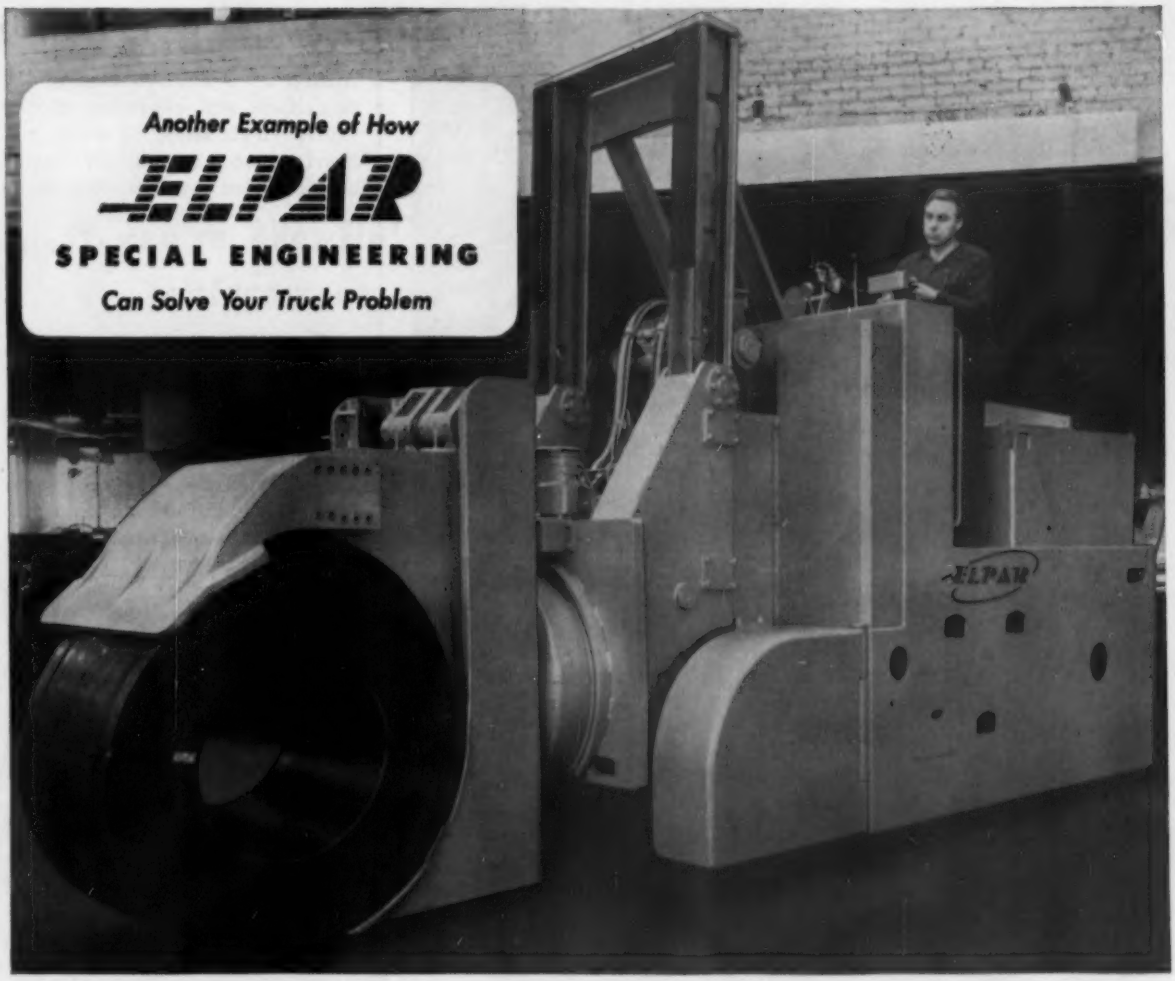
Bettmann Archive

MATERIALS HANDLING equipment used in rolling sheet iron in an early mill.

Bleat and Stupidity

Washington, July 16.—The heat and humidity of Washington must account for its increasing bleat and stupidity. . . . For if it is possible to raise the ratio in that direction, it is being done. . . . Hot words become hotter. Panaceas in the name of recovery become panicky. . . . The Ananias club instituted under Roosevelt the First loses all semblance of exclusiveness as charges of "liar" are bandied back and forth under the regime of Roosevelt the Second. . . . They take in members both from within and from without the Administration, running from the top down. . . .

Congress, lashed to its sweltering job that produces more swelter than worth-while work, is told to wrestle its way through "must" legislation. . . . But it hopes now to close up and give a baffled country a rest by Aug. 15, unless it stages a real revolt and gets away



Progress in Metal Handling by ELPAR Trucks

Elwell-Parker engineers specifically designed this new truck for improved handling of strip steel coils. It has a large clamp and rotating head, so that coils can be picked up, transported and stored *in any position.* This highly successful unit will one day be standard in mills because it ends costly rehandling, speeds production, and saves storage space.

This is a typical example of the many units Elwell-Parker has developed for:

Steel Mills
Forging & Stamping Plants
Metal Fabricators
Foundries

Such "heavy" industries require *heavy-duty* truck service. That is another reason why they use dependable ELPAR Trucks, which provide efficient, low-cost handling even on the toughest metalworking jobs.

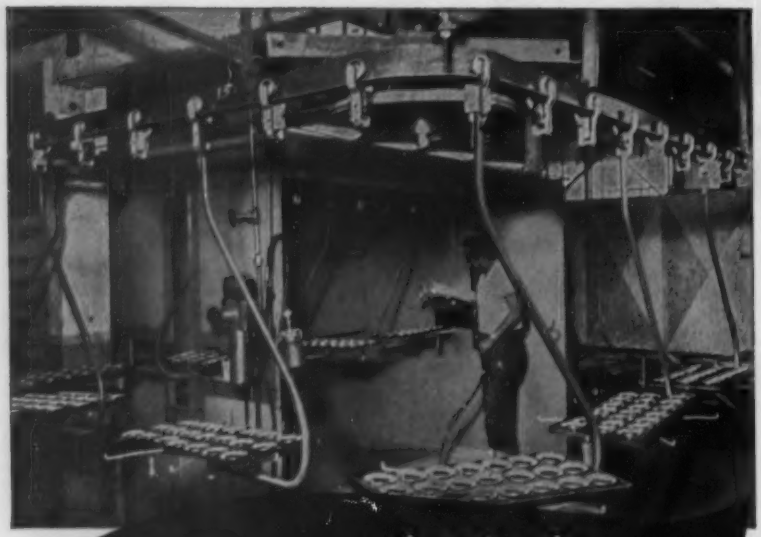
FREE CATALOG

Describes ELPAR Trucks in detail. Please name your industry when writing.



THE ELWELL-PARKER ELECTRIC COMPANY
4336 St. Clair Avenue • Cleveland 3, Ohio

ELPAR
INDUSTRIAL TRUCKS







"Buschman also engineers and manufactures a complete line of wheel, roller, belt, slat and special conveyor systems."

LOWER INITIAL COST — Buschman "Universal" Cable Conveyors not only cost less but also outperform heavier, more expensive conveyors for light and medium-weight applications.

LOWEST MAINTENANCE COST — Constant take-up readjustment is eliminated because of a safety factor of 14-to-1 or greater.

LOWEST REARRANGEMENT COST — Exclusive Buschman design plus lightweight all-bolted construction make future changes fast and easy.

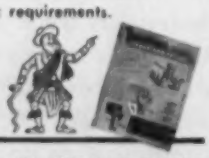
MORE COMPACT DESIGN — Shorter radius curves and dips permit more complete utilization of production and storage space . . . both overhead and at work level . . . require less room inside industrial ovens, washers, dip tanks, etc.

SMOOTHER OPERATION — There are no pulsations or jerks to damage delicate parts or finishes when your product is handled on Buschman Cable Conveyors.

PRE-ENGINEERED — Using Buschman standard stocked parts, your own crew can set up a "Universal" Cable Conveyor tailored to your specific requirements.

PRODUCE MORE . . . FOR LESS
Buschman Conveyors
C-205-A-EWB

Write today for catalog.



THE E. W. BUSCHMAN COMPANY
4449 Clifton Avenue • Cincinnati 32, Ohio
Representatives in Principal Cities
Complete Conveyor Systems For All Types of Industries • Engineered • Manufactured • Installed

sooner. . . . Yet considering the magnitude and character of the "must" legislation, it could not nearly clean it up if given studied consideration by the date indicated. . . .

July 18, 1935

Chattanooga Outlook

A press telegram from Chattanooga, dated the 16th inst., says: "The industrial outlook is brightening very materially. The Citico (100-ton) Furnace, which has been out of blast for four months, began operations today and will make its first cast next Monday. Chattanooga Furnace, which has been out of blast two weeks, resumes on Monday. The forces of hands at the Alabama Great Southern car shops and at the Chattanooga cotton factory are being increased on account of inpouring orders, and all the iron men report an extraordinary increase of inquiries from all parts of the country. Three sawmills started up to-day and two more will start next week."

Jan. 22, 1885

Labor's New Policy

Labor's new policy of cooperation with management to promote production was emphasized in an address by William Green, president of the American Federation of Labor, before the Taylor Society and the management division of the American Society of Mechanical Engineers in New York last week. The speaker made it clear that unionism is no longer opposed to labor-saving machinery, to the stopping of waste and to other methods of getting efficiency. On the contrary, he said, it desires to increase the fruits of industrial progress and to share in the increment.

Dec. 10, 1925

If you're growlin' about replacement costs . . .

IT'S TIME TO SPECIFY MONARCH INDUSTRIAL SOLID TIRES

IF YOUR COMPANY HAS MONEY "TO BURN" . . . TURN THE PAGE. We are talking *only* to buyers who want to reduce solid tire replacement costs . . . with no sacrifice of performance or quality. That's our specialty. That's why Monarch gives you premium lift truck tires at standard prices.

Monarch pressed-on solids are manufactured from higher quality materials than *the best premium passenger car tires.* This is no idle claim! Our tires last longer because they actually are made better. It's as simple as that.

We can supply a complete range of types and sizes to meet every normal or special need.

If economy is your goal . . .
MONARCH IS YOUR TIRE!



THE MONARCH RUBBER COMPANY

230 LINCOLN PARK • HARTVILLE, OHIO
7-255 General Motors Bldg., Detroit 2, Mich.

6194-MR

TORTURE TESTS PROVE...





Engineered fatigue tests . . . on these standard tires . . . produced these results

For the complete story, write for Bulletin TD-200.

. . . MONARCH Mono-Cushions® WEAR BETTER . . . LAST LONGER

NEW! LETOURNEAU ELECTRIC HOIST and JIB CRANE



Built for Your

BIG LIFTS

With Instant "Inching" Control!

LeTourneau Electric Hoists give safe, absolute control of any rated load. When power is applied, you'll have instantaneous, full-torque starts from the LeTourneau Electric Motor. Cut the power and mechanical-electrical three phase brake instantly stops and holds the load. Regenerative braking controls the lowering of the load. Big loads can be moved a fraction of an inch at a time for perfect positioning. All welded steel construction; available with all standard mountings. Three tons to 30 tons and *UP!*

LeTourneau Jib Cranes reach out 25 feet in all directions to pick up, move, and spot your load. Boom rotates 360° on roller bearings and in bronze-lined ball socket for smooth, easy manual operating – even with capacity loads. From 6 to 15 tons capacities. Boom clearance, 14½ feet with maximum overhead clearance of 18 feet, 2 inches. With or without hoist.

You owe it to your factory to get complete information on LeTourneau Jib Cranes and Hoists – write today for Bulletin 618.

LETOURNEAU EQUIPMENT

R. G. LETOURNEAU INC

LONGVIEW, TEXAS, U. S. A.

R. G. LeTourneau, Inc.
2626 South MacArthur, Longview, Texas, U. S. A.
☐ Please send me Bulletin 618 on LeTourneau Hoists
☐ Please send me information on LeTourneau Jib Cranes
☐ I am interested in a distributorship for LeTourneau Jib Cranes and Hoists

Name_____
Title_____
Company_____
Address_____
City, State_____





Bettmann Archive

THE UNICYCLE, invented by a Yankee about 1869, helped move men faster.

Iron Curtain

The Standard Theater, in this city, has an iron curtain. This, in case a fire should originate on the stage, will prevent it from spreading to the auditorium for at least 20 minutes, thus giving the people ample time to escape from the building. A similar arrangement should be provided in every place of amusement, but the curtain should be held in place with inflammable ropes, and not with wire ropes, so that a fire would automatically lower the curtain in case of panic-stricken employees.

Jan. 1, 1885

High Purity Iron

Iron of such purity that it is difficult to analyze for the metalloids is being produced at the plant of the Niagara Electrolytic Iron Co., Niagara Falls, N. Y. This result is had by depositing the iron upon a steel mandrel through the use of ferrous chloride as an electrolyte and using anodes of blast furnace iron. The tubes so produced, when separated from the mandrel by an ingenious kneading process, may be converted into strips or other forms for commercial use.

Sept. 10, 1925

New Steel Wire Use

One of the newer uses to which it is proposed to apply steel wire, in a braided or woven form, is its adaptation to belting for driving machinery of all kinds. Some things may be said both for and against this use of wire, but, as in so many kindred things, the choice must often lie in the general expediency of the given case, as to whether a skillful hand will be likely to be near by to take care of the wire belt when it reveals some one of the trifling early tendencies to a need of repair which with such fixtures generally appear only to one searching carefully for them. It is worthy of note that the makers of wire are compelled to look earnestly and over wide areas for new outlets for the product of their mills. The advance in the efficiency of these mills, including especially the trains for rolling the wire rods, within three or four years has been something surprising: in fact, it is a clear case of the adaptation of a genuine high-speed class or type of machinery to a line of work which had previously been done at somewhat less speed and at far greater cost for repairs of the fixtures than these later mills have yet required.

Feb. 12, 1885

Explains Flame

Large furnaces must apparently replace small ones. Mr. F. Siemens has proved that solid substances interfere with the formation of flame, and that flame injures solid substances with which it comes in contact. To account for the phenomena he advances, preferably, an electrical hypothesis. Accordingly, he explains flame as the result of an infinite number of exceedingly minute electrical flashes, the flashes being due to the very swift motion of gaseous particles, and a solid body which opposes it-



AIR LIFT
for heavy materials

Crowded isles and sluggish flow of materials cost you money. So why not go over the top! You can speed production, cut your costs with Conco Cranes, custom designed for your specific needs. Let us show you how. Write for a trained Conco engineer to call and make recommendations, or request bulletin 3000A covering our complete Conco line. Conco Cranes are backed by 37 years of experience.

CONCO ENGINEERING WORKS
Division of H. D. CONKEY & COMPANY
15 Grove Street, Mendota, Illinois

CRANES HOISTS CONCO

AFFILIATES
CONCO ENGINEERING WORKS—Domestic Heating Equipment
CONCO BUILDING PRODUCTS, INC.—Brick, Tile, Stone



with

R-W "Zig-Zag"®

Photo above clearly shows extreme flexibility possible with Zig-Zag Conveyor. Note short radius return curve, variety of dips and rises, and minimum superstructure.

CONTINUOUS POWER CONVEYORS

With America's ever-expanding economy comes the need for more production space. And, when space is at a premium, cramped working conditions and materials-handling bottlenecks always appear.

Today, more and more companies are finding a solution to these problems with Richards-Wilcox ZIG-ZAG Continuous Power Conveyors. ZIG-ZAG Conveyors operate *continuously . . . overhead . . .* keeping things moving on the production line and between departments, and releasing valuable floor space for other purposes.

ZIG-ZAG Conveyors operate with maximum economy, versatility and flexibility. They move up, down, in, out and around, "like water through a pipe". ZIG-ZAG is designed to handle in continuous production any load a man can lift. Carrying pendants are located on 6-inch centers and a choice of drive units permits travel at any required speed with variations of 10 to 1 or better. And when changing conditions require alteration, expansion or relocation of ZIG-ZAG Conveyors, the job can be easily performed by plant personnel, usually without waste of a single part.

Richards-Wilcox ZIG-ZAG Continuous Power Conveyors keep production on the *go*. For full information on how they can help you, write for descriptive catalog No. A-93.

75 YEARS of QUALITY and SERVICE by RICHARDS-WILCOX AURORA, ILLINOIS

Richards-Wilcox Mfg. Co.

MATERIALS HANDLING DIVISION

Branches in Principal Cities

415 W. THIRD STREET, AURORA, ILL. SLIDING DOOR HANGERS & TRACK • FIRE DOORS & FIXTURES • GARAGE DOORS & EQUIPMENT • INDUSTRIAL CONVEYORS & CRANES • SCHOOL WARDROBES & PARTITIONS

self to these flashes is cut by them, while, the motion being more or less arrested by the solid body, the flame is damped. Mr. Siemens insists, therefore, that flame must not be allowed to impinge upon bodies to be heated, but must simply heat the bodies by radiation, and furnaces must be so constructed as to allow the flame to develop out of contact not only with the substance on its bed, but with the walls and roof of the furnace itself.

Jan. 1, 1885

Add New Machines

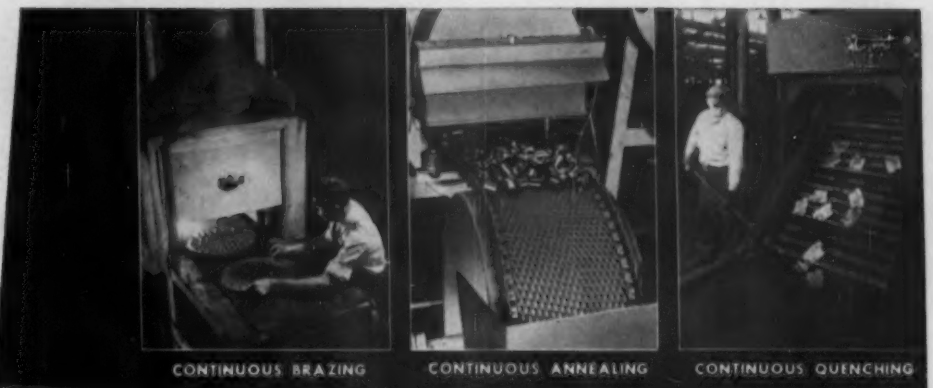
Russell, Burdsall & Ward, of Port Chester, manufacturers of bolts and nuts, have received the medal and diploma for their exhibit at the Centennial. This firm employs a force of 250 hands, which, with their peculiar labor-saving machinery, performs the work of 500. One of the best evidences of the esteem in which their goods are held is the fact that, notwithstanding the general depression of trade, they have run their works to their fullest capacity the whole season, and being unable to keep pace with their orders, are now putting in a large amount of additional machinery.

Nov. 9, 1876

Rumors of War

The Smith & Wesson Pistol Company, Springfield, with the wars and rumors of wars, find themselves compelled to enlarge their quarters, and will put an extension of 100 feet on their Stockbridge street factory, enlarging its capacity 40 per cent, and allowing of the employment of nearly 850 men.

Nov. 9, 1876



CONTINUOUS BRAZING | CONTINUOUS ANNEALING | CONTINUOUS QUENCHING

HERE'S WHAT *Cambridge*

...first in woven wire conveyor belts...

MEANS TO YOU!

QUALITY

The materials used in your Cambridge belt are purchased from dependable suppliers and stocked in quantities sufficient to assure availability. Among these is a complete line of "Cambriloys" . . . low, medium and high temperature alloys for continuous operation up to 2100° F.

Cambridge production methods mean a better-made belt with longer life and lower maintenance. Smoother, more uniform welds form a stronger selvage for easier control of belt travel. Accurate mesh count and wire size assure exact mesh size. Cambridge spiral construction gives you the strength of round spiral and the smooth surface of the flat spiral . . . minimizes tool marks and scars on wire and cross rods. Uniform crimping produces straight, flat belts.

PROGRESS

Cambridge Engineers are continually improving on "Balanced", "Duplex", and "Rod-Reinforced" weaves. In addition, we are constantly developing new features, such as the high temperature "Cambriloys," and others developed FIRST by Cambridge. Rubber-coated and Teflon-coated belts are examples of specialized belts available to fit your needs.

SERVICE

Experienced engineers, both in the field and in the home office, are thoroughly familiar with basic conveyor design, able to give you on-the-spot recommendations on how best to apply continuous, uniform processing to your operation. Then, we'll produce just the right belt for you.



GRIPPER SLINGS illustrate the Cambridge thinking that can work for you. Utilizing the strength, flexibility and durability of woven wire, Gripper Slings provide easier and safer handling or processing. Extra broad bearing surface grips load better, yet is flexible enough for coiled storage. Won't kink or tangle. Standard widths and lengths available to 50-ton capacity.

THESE ARE THE REASONS WHY 1 OUT OF 8 NEW INSTALLATIONS OF CAMBRIDGE BELTS RESULTS FROM THE RECOMMENDATION OF A SATISFIED CUSTOMER.

Call in your Cambridge Field Engineer—he's listed under "Belting, Mechanical" in your phone book—OR, write for FREE 130-PAGE REFERENCE MANUAL giving mesh specifications, design information, metallurgical data and typical applications.



The Cambridge Wire Cloth Co.

WIRE CLOTH | METAL CONVEYOR BELTS | SPECIAL METAL FABRICATIONS

Department AB, Cambridge 6, Md.

OFFICES IN PRINCIPAL INDUSTRIAL CITIES

BIG cranes for BIG steel

(FAIRLESS WORKS)



30-ton capacity, telescopic ram, low head room soaking pit crane. 106'-0" span. Tong range 12" min., 72" max.

The four cranes illustrated on these pages are the largest of their type in the world. They were created by teams of Alliance and U. S. Steel engineers for U. S. Steel's new Fairless Works.

Alliance cranes function in virtually every department in the mammoth Morrisville plant—day in and day out—safely, efficiently and economically . . . helping to establish new production records.

The techniques embodied in these giant cranes can be embodied in cranes designed for operation in your plant. When it's time to consider your crane requirements come to Alliance. We'll be glad to analyze your needs and work with you to effect the most efficient and economic solution of your problem.

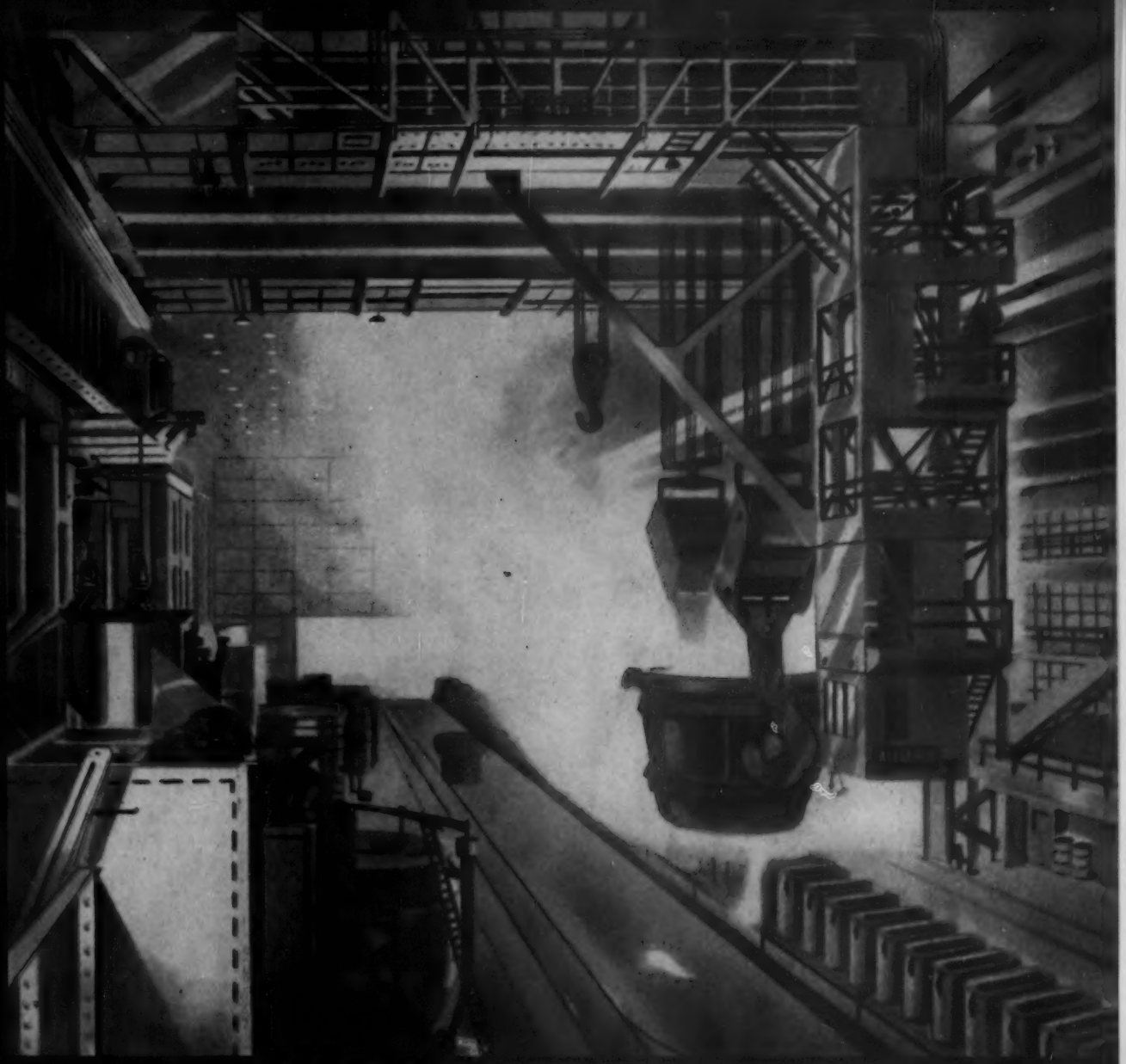
"Give Us the Runway and We'll Lift the World"

THE *Alliance* MACHINE COMPANY

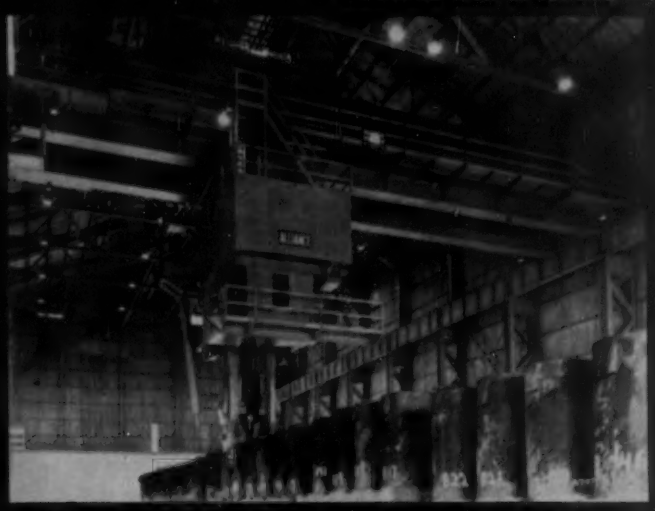
Main Office, Alliance, Ohio — *Founded 1901*

LADLE CRANES • GANTRY CRANES • SOAKING PIT CRANES • STRIPPER CRANES
FORGING MANIPULATORS • SLAB AND BILLET CHARGING MACHINES • OPEN HEARTH
CHARGING MACHINES • SPECIAL MILL MACHINERY • STRUCTURAL FABRICATION

World's Largest Builders of the World's Largest Cranes



450/75/20-ton 4-girder ladle crane with 69' 6" span. 2-motor, synchronized worm drive. Vibrationless under all operating conditions. Operator's cab air-conditioned.



400-ton capacity push-pull Stripper and Extractor Crane. 2.5-million-pounds pressure eliminates stickers. Overload rating of 1250 tons. One operator.



200/30-ton 4-girder double trolley hot metal ladle crane, 80' span.

HERE'S VERSA

AUSTIN-WESTERN HYDRAULIC CRANE

PRODUCTION "CHAMP"





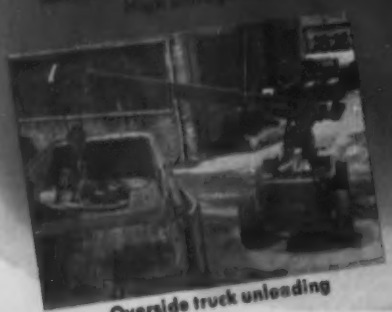


Factory appears bad



High average indoors

It's the LIVE BOOM that makes the difference . . . live power for all boom movements . . . extending and retracting . . . raising and lowering . . . rotating. Finger-tip hydraulic control handles delicate spotting jobs with superb precision. No other mobile crane has a boom so completely "alive" . . . no other outdoor-indoor crane is so well adapted to the handling of materials-for-production.



Override truck unloading



Stockpiling steel beams



Multi-use magnet

Austin-Western

Power Graders · Motor Sweepers
Road Rollers · Hydraulic Cranes

BALDWIN BLH LIMA-HAMILTON

Construction Equipment Division

Manufactured by
AUSTIN-WESTERN COMPANY
Subsidiary of Baldwin-Lima-Hamilton Corporation
AURORA, ILLINOIS, U.S.A.

TIGHT!



AUSTIN-WESTERN HYDRAULIC CRANE
MAINTENANCE "CHAMP"

The same exclusive features that make the Hydraulic Crane popular with production departments are responsible for its equal popularity with maintenance departments, where its all-wheel steer for close quarter operation, telescopic boom with 360° rotation, and fast, accurate hydraulic controls make it a "natural" for dozens of maintenance jobs, indoors and outdoors . . . a versatile, always-on-the-job top performer which pays maximum dividends, day in and day out.







Changing conveyor chain



Transporting pipe section



Storing steel plate



Magnet handles pipe



Replacing gear

Get all the Facts...



AUSTIN-WESTERN COMPANY
640 Farnsworth Avenue, Aurora, Illinois
Please send complete information and literature on the Austin-Western Hydraulic Crane.

Name _____
Title _____
Company _____
Street _____
City _____ **Zone** _____ **State** _____



At the Touch of a Button

...FASTER HANDLING, LOWER COST

● Here's how a typical plant turned a slow, costly handling job into a simple push-button operation. Consider the savings you might get in time, money and manpower by following a similar step.

The job was to remove wire from winding drums and convey it to the next operation. To reduce costs, a new idea was tried: a ½-ton, single I-BEAM READING ELECTRIC CRANE was custom-built for the job. All motions were motorized. Now one man controls the entire operation faster and more economically—by simply pushing the right button!

If you, too, are looking for a way to speed up your own materials handling, and save money doing it, here's the step that can pay off for you. Simply get in touch with READING. At no obligation, one of our engineers will gladly analyze your handling requirements and give you a practical recommendation for obtaining the results you want. A note on your letterhead will put him to work.

Reading Crane & Hoist Corporation, 2101 Adams Street, Reading Pa.

READING CRANES

CHAIN HOISTS · OVERHEAD TRAVELING CRANES · ELECTRIC HOISTS

Sharp Price Advance

There has just been a sharp advance in the galvanized sheet market, about twice as much as in black sheets, and due to a stiff advance in the zinc market. The tin plate price for the new season is to be developed within a few weeks, and there is talk in the trade that there should be an advance, because tin has been going higher.

The tin and zinc advances, together with that in lead, direct attention to the behavior of these metals as contrasted with prices of copper, pig iron and finished steel. There is a remarkable divergence. Copper is cheap and the iron products are relatively cheap.

Nov. 12, 1925

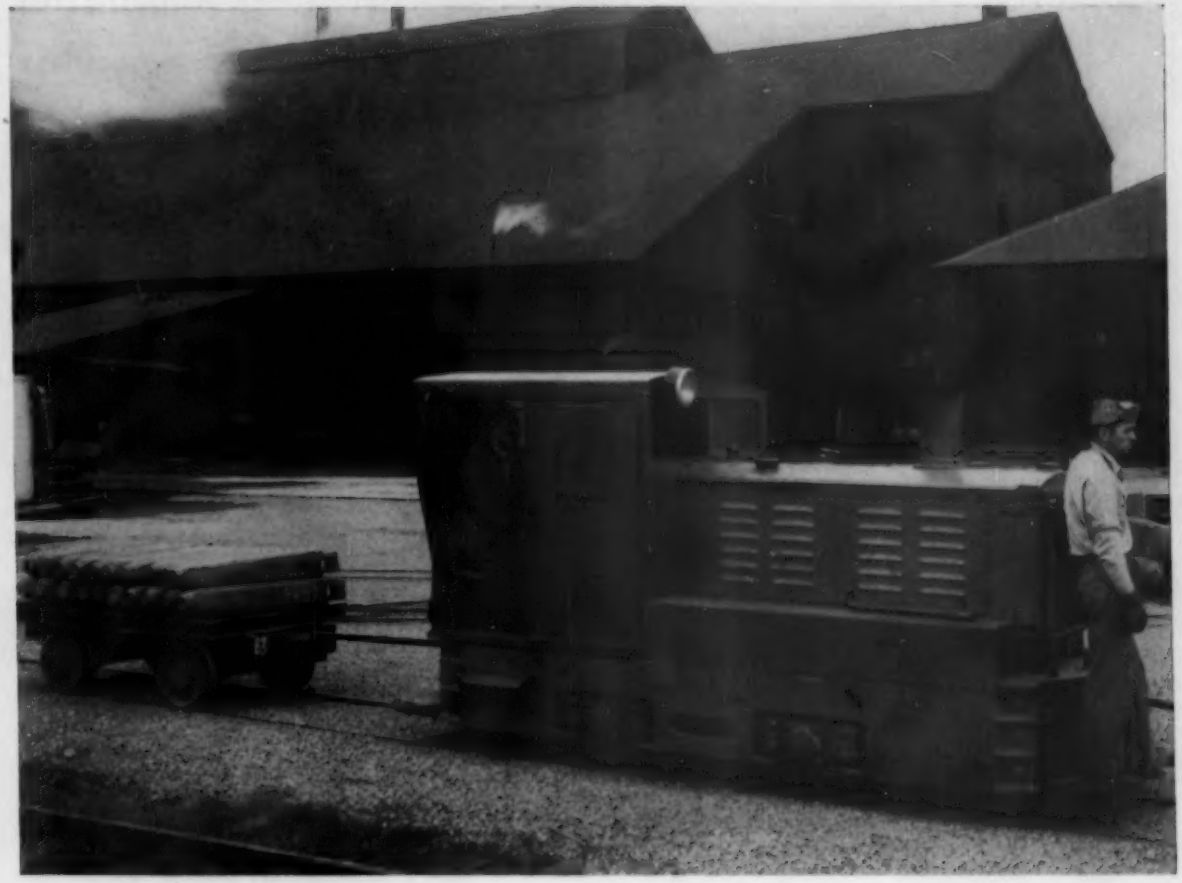
Editor Gives First Hand Account of Ore Find

This is the first eyewitness story by an American reporter on U. S. Steel's strategic iron ore find in Venezuela. Tom Campbell flew 5500 miles, rode 200 miles in jeeps and cruised up and down the Orinoco to get material. The first article ever to be published on Cerro Bolivar was in THE IRON AGE, Dec. 30, 1948, a year before recent publicity.

Ciudad Bolivar, Venezuela — Mack C. Lake, the perennial and respected explorer around the globe, is only partly satisfied today. He is entering one of the most important phases of his career—after closing one of the most exciting and brilliant ones.

U. S. Steel has found the iron ore it so badly needed. Mack, now president of the newly formed Orinoco Mining Co., has the job of supervising building of a railroad, docks, terminals and getting the ore coming into the Eastern coast within 5 years. From what has been done in the past 5 years there are no worries over the latest assignment. . . .

Mar. 2, 1950



PLYMOUTH TORQOMOTIVE

SLASHES REPAIR COSTS AND DOWN TIME

for Colonial Steel Division

"We were plagued with repair costs and harassing delays until we replaced our mechanical drive locomotive with this 7½-ton Plymouth Torqomotive," says the Works Manager of Colonial Steel Division.

"Besides eliminating repair costs during the four years we have operated the Torqomotive, we have spent an average of only six hours a month for routine maintenance. Starts and stops—and we have plenty of them—are much smoother now, and our operators like the ease with which they can switch and spot the cars."

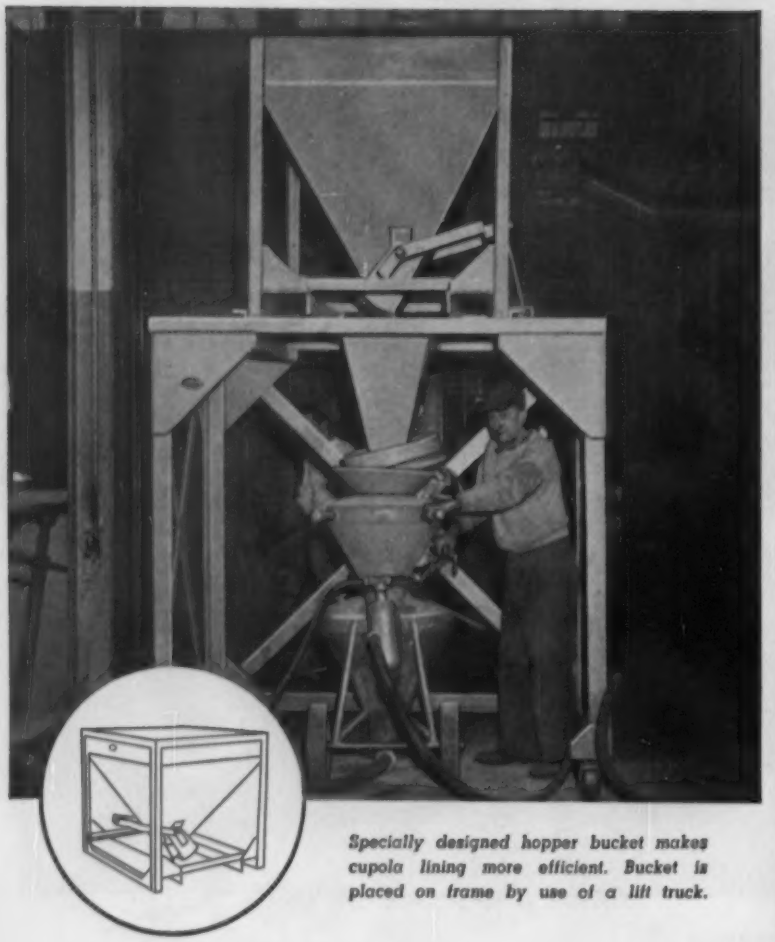
Yard work is hard work—but just one of the many jobs a Plymouth handles with ease. Whatever your hauling, switching or spotting problems, there's an answer in Plymouth's dependable, cost-cutting performance. Models range from 3 to 70 tons. Gasoline or Diesel, mechanical or Torqomotive Drive.* Also Diesel-Electrics.

Write today for a free catalog giving details and performance data. PLYMOUTH LOCOMOTIVE WORKS, Division of THE FATE-ROOT-HEATH COMPANY, Dept. A-2, Plymouth, Ohio.

PLYMOUTH® TORQOMOTIVES

*TORQOMOTIVE DRIVE: Plymouth Transmission coupled to a Hydraulic Torque-Converter

ALSO BUILDERS OF F-R-H CERAMIC MACHINERY



Specially designed hopper bucket makes cupola lining more efficient. Bucket is placed on frame by use of a lift truck.

Solve Your Material Handling Problems With PENN IRON SPECIAL EQUIPMENT

In lining cupolas, Textile Machine Works foundry in Reading, Pennsylvania, had difficulty handling the clay mix used with their Bondactor equipment. After a study of the problem, Penn Iron Works, Inc., designed, engineered and manufactured this special hopper bucket for maximum handling efficiency.

Whatever the bulk-material handling problem in your plant, Penn Iron Works, Inc., will be glad to help with its solution. Our wide experience in designing and manufacturing all types of buckets and special handling equipment for foundries can help you cut costs . . . save time . . . increase efficiency.

For Further Information Write:

FEMA

PENN IRON WORKS, INC.

READING, PENNSYLVANIA

Fall Trade Suggestions

Let country merchants make the farmers pay, and compel them in future to buy for cash. If they do not get cash now, they will not for twelve months. Friends bear this in mind, and do not order more goods than you can safely sell. Forget not, we pray you, the lesson of 1857.

August, 1859

Coming Apart At the Seams

Washington, July 9.—The New Deal begins to resemble a tatterdemalion. Its glamorous garment of planned economy has become badly torn. . . . Worse yet, parts are missing. . . including the pants. . . . This section of the ensemble was most highly prized economically as well as being socially desirable. . . . But an inconsiderate Supreme Court snatched away this essential of raiment, known as NRA, now faded and hardly more than a fitful memory.

The Worm Will Turn

Even the worm will turn. . . and the House of Representatives, recovering some of its dignity and self-respect, revolts and, in the face of the club of Administration lobbyists, deals a smashing blow against the "death" sentence clause in the holding company bill. . . . A mighty sock it was. . . . The smoke screen for an investigation of public utility lobbyists was countered with an investigation also of Administration lobbyists . . . and like most investigations will gain the front page for awhile and then go into the limbo with other forgotten things.

Who Is A Lobbyist?

Who is a lobbyist? . . . the other fellow? . . . And has business no right to defend itself against confiscatory legislation? . . . Business and its stockholders, the latter made up of many in the family of



How to Estimate Your Materials-Handling Savings With *Cargotainers*®



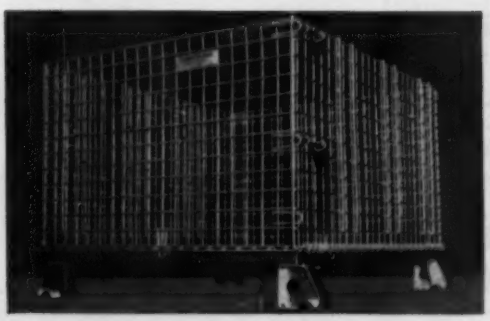
This new 24-page booklet, "How to cut materials-handling costs with new Duty-Designed Cargotainers," is packed with factual information obtained from leading manufacturers of all kinds of products. It contains actual case histories with photos showing Cargotainers at work on production lines moving all kinds of products from food, auto parts, pipe fittings to textiles. It shows the many different types of folding, stacking Cargotainers from stock models to special designs for your particular merchandise.

Send today for your free copy. It's yours for the asking.

Pittsburgh Steel Products Company

a subsidiary of Pittsburgh Steel Company

1409 Grant Building • Pittsburgh, Pa.



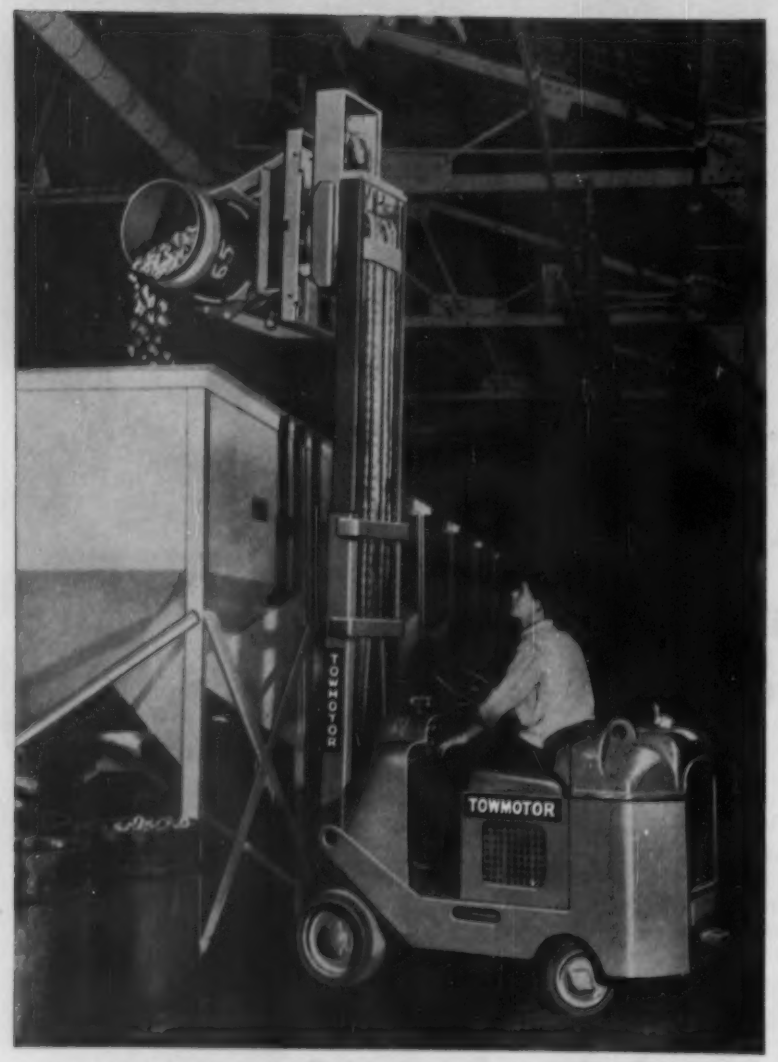
Gentlemen: Please send me your 24-page booklet "How to cut materials-handling costs with new Duty-Designed Cargotainers" without cost or obligation.

NAME *TITLE*

COMPANY

ADDRESS

TOWMOTOR
THE ONE-MAN-GANG
FORK LIFT TRUCKS
at Columbia Malleable Castings Corporation



300% PRODUCTION INCREASE

. . . Overall Handling Costs Cut 60%

Job-Planned Towmotors now pour finished parts into hoppers using a Revolving Barrel Grab. Parts feed down to a weighing conveyor and are bagged mechanically for shipment. Manual filling was eliminated and output per man increased 300%. Overall, Towmotor cut handling costs 60%.

Towmotor equipment does wonders in every plant where handling is a problem. For more information write for Job Studies covering your industry, your competition. TOWMOTOR CORPORATION, Div. 1506, 1226 East 152nd Street, Cleveland 10, Ohio.

FOR FAST ACTION—See a Material Handling Specialist—your nearby Towmotor Representative. His factory training will show you the quickest way to attain maximum handling efficiency at minimum cost.

John Q. Public, in turn make up constituencies of the revolting house members . . . and some of latter frankly said it was because of the demand from these voters that they voted against the death sentence. . . . When these voters speak one way and the White House the other way, the voice of the latter is weak indeed. . . . The significance of the blow was emphasized by the fact that the House previously had truckled to every piece of legislation sent to Congress by the White House. . . .

July 11, 1935

Hoover Report on Waste

The annual report of Secretary of Commerce Hoover for the fiscal year 1925 is divided into two parts, dealing respectively with "Processes in Elimination of Waste" and "Economic Review." The former section was released to the press Tuesday, while the latter part was made public Nov. 7. The secretary says that great progress has been made during the year, in the national movement for elimination of industrial waste and that the department has devoted much of its activities to this end. He points out that the program is one fundamentally to stimulate action among industries, trades and consumers themselves, and that it is obviously not the function of the Government to manage business, but to investigate economic questions, etc.

Dec. 10, 1925

Horse and Mule Shoes

Trade continues rather quiet, and prices remain unchanged; Shoenberger & Co. still quote (Juanita) at 4½c. for the former and 5½c. for the latter.

Oct. 26, 1876



Pre-engineered standard units for conveying, elevating and processing mean lower initial investment because "made-to-order" costs are minimized. And when the standard units are Jeffrey engineered, production is bound to get a big lift.

Jeffrey flexible standard units provide almost limitless combinations to meet industrial conveying and processing requirements.

At the plant shown above, a Bucket Elevator lifts material to a Mechanical Vibrating Conveyor which delivers to silos. Also at work at this installation are Jeffrey Electric Vibrating Feeders, Spiral Conveyors, Weigh Feeders and Crushers.

Write for catalogs containing complete information.

Jeffrey standardized units—singly or in an integrated system—can be applied to your materials handling and processing operations efficiently and economically. Listed below are Jeffrey Standard Units for moving and processing materials:

- Apron Conveyors
- Batchers
- Belt Conveyors
- Bucket Elevators
- Coolers
- Dryers
- En-masse Conveyors
- Feeders
- Jigs
- Magnetic Separators
- Mixers
- Power Scoops
- Pulverizers
- Scraper Conveyors
- Spiral Conveyors
- Stackers
- Vibrating Conveyors

THE JEFFREY MANUFACTURING CO.

ESTABLISHED 1877

Columbus 16, Ohio

sales offices and distributors in principal cities

PLANTS IN CANADA, ENGLAND, SOUTH AFRICA

IF IT'S MINED, PROCESSED OR MOVED
. . .IT'S A JOB FOR JEFFREY!

Baker INDUSTRIAL TRUCKS

A CENTURY OF TOP

tops in 1853



WAGONS and CARRIAGES

100 years ago our company started in business as a blacksmith and wagon shop.

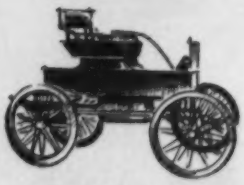
tops in 1890



DE-LUXE CARRIAGES

Skilled craftsmanship soon earned the reputation of producing the country's finest custom-built carriages.

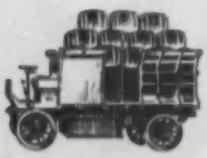
tops in 1898



FIRST BAKER ELECTRIC

This electric "horseless carriage" started Walter C. Baker in the motor vehicle business.

tops in 1910



FIRST ELECTRIC ROAD TRUCK

Durability and economy made this the best commercial vehicle in its day. In two years it was accepted in over 100 different trades.

tops in 1912



ELECTRIC "PADDY WAGON"

Catalog description: ". . . economy in your police department compared with horse drawn patrol . . . desirability from a *humane* and *sanitary* viewpoint".

tops in 1915



FIRST AUTOMATIC TRANSMISSION

The handsome "Owen Magnetic", Baker-built gas powered automobile with electric drive predated other automatic transmissions by 30 years!

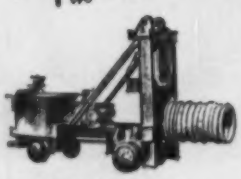
tops in 1917



FIRST BAKER INDUSTRIAL TRUCK

Baker pioneered mechanized material handling, entering the field 43 years ago. First Baker Industrial Truck, built in 1917, is still in daily use.

tops in 1922



FIRST RAM TRUCK

The first cantilever type self-loading industrial truck with mast and carriage for lifting loads mechanically. *FORE-RUNNER OF ALL FORK TRUCKS!*

tops in 1924



FIRST "LOCOMOTIVE" CRANE

Designed originally for assembly and maintenance of locomotives, the mobile electric crane was quickly accepted for a wide variety of industrial handling jobs.

tops in 1936



FIRST ARTICULATED FORK TRUCK

Radical design which steered by pivoted frame. Used for stacking in warehouses with narrow aisles and for certain car-loading operations.

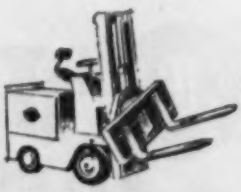
tops in 1942



FIRST HYDRAULIC HY-LIFT®

The first hydraulic lift for a Hy-Lift® Platform Truck was introduced by Baker during this year.

tops in 1952



FIRST ALL PURPOSE TRUCK

Combines fork clamping, spacing and side-shifting. With revolving head added, produces the "Octopus", which handles any shape load and stacks it in any position.

BAKER ACHIEVEMENTS

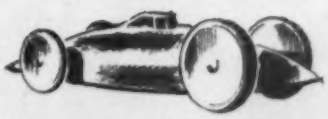
tops in 1902



FIRST DRIVE SHAFT AUTO

pioneer in automotive engineering, aker introduced the first drive shaft and ear axle bevel gear over 50 years ago.

tops in 1903



FASTEST THING ON WHEELS

"Torpedo"—Baker designed and built racing car sped 10 miles in less than 5 minutes. Top estimated speed was 132 MPH.

tops in 1905



SHOW-CASE ON WHEELS

First American car commercially equipped with closed body. One of the finest autos of its day, with spacious windows and smart interior. Many still in use!

tops in 1916

BAKER-RAULANG and IRON AGE —partners in giving industry a "lift" for 100 years

Two vital factors in our tremendous industrial development during the past century have been *communications* and *material handling*.

Baker-Raulang—now in its 103rd year of giving industry a literal "lift" by its notable contributions to the science of transportation and material handling—salutes Iron Age—now celebrating its 100th birthday of devotion to the equally important science of communications.

Manufacturers like Baker-Raulang are continually developing new products and techniques for expanding the cost-cutting possibilities of mechanized handling. Publications like Iron Age are reporting them. This partnership enables our industrial economy to take giant strides toward greater and greater production efficiency.

Baker's modern new line includes gas and electric powered fork trucks, platform trucks, crane trucks, tractors, side-loading fork trucks and front-end loaders. Every unit in the line is designed for the utmost in economy, efficiency, low maintenance, dependability and long life.

Early this year Baker-Raulang was purchased by Otis Elevator Company—another centenarian founded in 1853, the identical year Baker started in business. The combined facilities, engineering know-how and material handling experience of these two companies are today teamed toward giving industry an ever-increasing lift during the next 100 years.

Write for your copy of the "Baker Handling Library" a new portfolio of application data.

THE BAKER-RAULANG COMPANY
1227 WEST 80th STREET • CLEVELAND 2, OHIO



Baker
industrial trucks

Most Specified for ORIGINAL EQUIPMENT POWER

WISCONSIN

HEAVY-DUTY Air-Cooled ENGINES

3 TO 36 HORSEPOWER



3 to 6 hp.



6 to 9 hp.



7 to 15 hp.



15 to 36 hp.

In the design, manufacture, and ultimate use-purchase of mechanized field and industrial equipment . . . Wisconsin Heavy-Duty Air-Cooled Engines are specified as Original Equipment Power Components to a greater extent than any other make of engine, within a 3 to 36 hp. range.

This dominant preference must necessarily be based on actual *performance records* of users . . . because Wisconsin Engines are not sold on a "price" basis. These engines have the inherent Lugging Power that *stays with the job*, eliminating "stop-and-go" delays, saving manpower and manhours . . . and delivering "Most H. P. Hours" of on-the-job service, with minimum servicing.

If this makes sense to you, let's get together. Write for engineering and descriptive data.

Power TO FIT THE JOB

Power TO FIT THE MACHINE



WISCONSIN MOTOR CORPORATION

World's Largest Builders of Heavy-Duty Air-Cooled Engines

MILWAUKEE 46, WISCONSIN

A 7991-½

SILENT HOIST KRANE KAR

"HAS GIVEN US EXCELLENT SERVICE AT LOW MAINTENANCE COST," says ATLAS FORGINGS COMPANY CICERO, ILL.

"KRANE KAR Unloads freight cars of billets weighing up to 6000 lbs. . . . Stacks them in yard . . . Transports billets to saw shop . . . Loads forgings on trucks for shipment. KRANE KAR is easier to use than our old stationary crane, and saves us time. Now we can make full use of our yard for billet inventory." Ask for Bulletin #79.

KRANE KAR

Swing-Boom Mobile Crane

Gas or diesel; adjustable telescopic boom; rubber tired; 11½ to 12½ Ton Cap.



Another SILENT HOIST "First" —FLUID DRIVE!



SILENT HOIST & CRANE CO.

Pioneer Mfrs. of Heavy Duty Materials-Handling Equipment

851 63rd Street, Brooklyn 20, N. Y.



QUOTES: 1855—1955

Re-entry Barred

The sharp cut in steerage rates by the Hamburg ocean lines is causing such a rush of impoverished people, on their return from America to the old country, that the German authorities have issued a proclamation that they will not be allowed to land.

Mar. 12, 1855

Alcohol from Coke

A short time ago it was noised that Germany was manufacturing synthetic alcohol on a large scale and that, in the near future, it would be in a position to land almost unlimited quantities of this commodity in America at a lower price than that at which the distilleries could afford to sell it. This allegation was soon afterwards denied; but considerable interest has been aroused in the subject. On the other hand, the petroleum situation is admittedly serious, especially in view of the tremendous increase in the demand for gasoline. The French, who are in a most disadvantageous position in this respect, have been studying the problem very seriously, and have found a partial solution in the substitution of alcohol for gasoline in explosion engines. The alcohol will be obtained as a by-product (along with many other valuable by-products) from coke oven gases, which at present are being burned.

Aug. 13, 1925

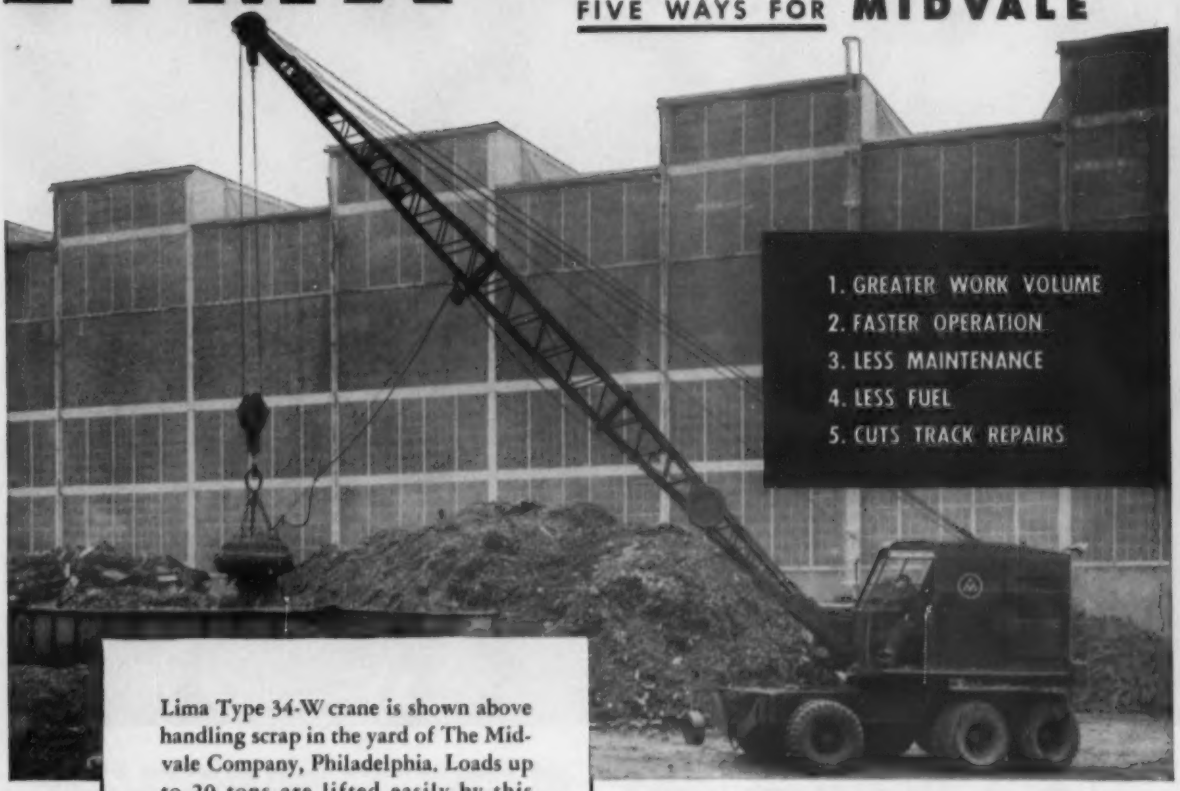
Early Invention

The first patent granted to an inventor in the United States is mentioned in a speech of ex-Senator Wadleigh, of New Hampshire, in the Forty-fifth Congress. The Senator said: "An intelligent gentleman of my own State has referred me to an act of the general

Turn to page F-42

LIMA CRANE CUTS COSTS

FIVE WAYS FOR MIDVALE



Lima Type 34-W crane is shown above handling scrap in the yard of The Midvale Company, Philadelphia. Loads up to 20 tons are lifted easily by this rubber-mounted crane which can roam everywhere around the plant.

We've just received a letter from The Midvale Company, Philadelphia, Pa. Since it tells so well how you can cut costs by switching to a Lima crane, we'd like to give you some key quotes from this letter:

1. "Our Lima crane does the work of two locomotive cranes, enabling us to scrap one and use the other only as stand-by equipment. This mobile crane's great maneuverability permits us to operate in areas previously restricted to available trackage. Also we've found many uses for it in construction projects and in handling materials within various buildings.

2. "Its faster operation has saved many hours 'on the job.'

3. "We find the maintenance on the Lima crane is considerably less than previously experienced on the other type crane. That's due principally to the simplification of running gear and the resultant decrease in number of parts which might require attention.

4. "Our records show that the unit cost in fuel consumption is not only less in the Lima crane during its actual operation, but even far less when you consider the greater work which can be done.

5. "In some plants using the locomotive type crane, track repairs and maintenance are a considerable item especially if they run no other railroad equipment."

In addition to cutting materials handling costs in these five ways, their Lima benefits Midvale in a way that is hard to measure in dollars and cents. Midvale reports: "Perhaps the greatest importance of the mobile crane is found in the preference of our engineers to operate it rather than our old type crane. This factor makes for better employee relations."

For more information on Lima cranes for materials handling, check with your nearby Lima distributor or write us for latest bulletins on 20, 25, 30, 35 or 45-ton cranes-on-rubber.

DISTRIBUTORS IN PRINCIPAL CITIES OF THE WORLD

LIMA

SHOVELS • CRANES
DRAGLINES • PULLSHOVELS

BALDWIN BLH LIMA-HAMILTON
Construction Equipment Division

BALDWIN-LIMA-HAMILTON CORPORATION
Construction Equipment Division
LIMA, OHIO, U.S.A.



FOUR INTERLOCKED CRANES handle 100-foot long trusses in structural plant. Cranes are 5 tons capacity, 3-runway, 36 and 40 feet long. They operate individually or together as units. Trusses are removed from jig and advanced to next location within a few minutes by two men operating crane control buttons.

TRAMRAIL IDEAS THAT



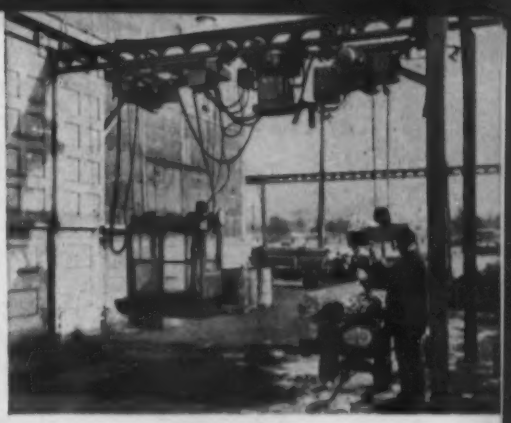
TRACK AND CRANE SYSTEM speeds automobile body fabrication. Tramrail cranes support spot-welding equipment and move assembled bodies between departments. Up to 105 bodies are produced per 8-hour day in this particular work area.



MOTORIZED GANTRY CRANE with spreader beam provides efficient handling in local area for bundles of tubing. Gantries can be hand-propelled, or partly electrified, or completely motorized like one illustrated.



EFFICIENT CRANE COVERAGE reduces time loss of skilled workers and expensive machine tools. Hand-propelled Tramrail cranes with electric hoists are an important factor in maintaining a profitable operation in this type of shop.



RAISE-LOWER CAB CARRIER permits operator leaving cab at any point to attach hooks to materials to be transported. Floor help is unnecessary and costs are consequently held at a minimum. This unit operates both outside and inside of the building.



HAND PROPELLED CRANE with one-ton chain hoist provides overhead conveying and hoisting service at low cost. Operation is smooth and easy, with practically no maintenance.

CUT COSTS...

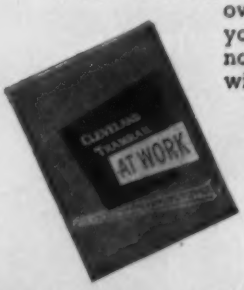
Whatever your handling needs, most likely versatile Cleveland Tramrail can be adapted to solve them.

In nearly every segment of industry, various forms of Cleveland Tramrail equipment are being used to advantage. In fact, over 40,000 installations are serving 9,000 companies.

The equipment speeds production, saves floor space, improves safety, reduces floor congestion — and cuts costs tremendously.

Cleveland Tramrail consists of track, switches, carriers, hoists, grabs, etc., which can be combined in a thousand-fold ways to exactly suit your need. Illustrated here are a few random examples of how the equipment is being used. Cleveland Tramrail can be furnished for simple manual operation or with any degree of electrification, including fully automated systems.

A local Cleveland Tramrail sales engineer will be glad to discuss overhead materials handling with you and show you installations at work in nearby plants. Why not get in touch with him? A card or letter to us will do the trick.



This large book is the greatest in its field. Contains a wealth of valuable information. Covers details of 143 outstanding installations. Has 426 large photos, 59 system layouts, 69 other sketches. Write for your free copy of "Cleveland Tramrail at Work" on your company letterhead. A nearby representative will deliver it without obligation.



THREE-WAY TRACK SWITCH enables this tractor-driven 5-ton electric hoist carrier to travel to various parts of a plant. This is another example of the many handling arrangements possible with Cleveland Tramrail.

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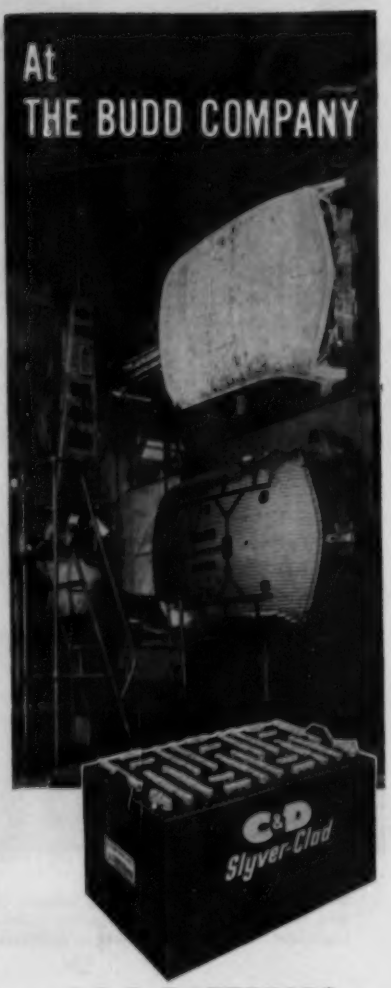
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court of Massachusetts Bay, passed in 1646, granting to one of his ancestors, Joseph Jenks, the exclusive right of making and selling his improved scythe for the term of 14 years. That, I think, was the first patent granted to an inventor in America. The improvement referred to changed the short, thick, straight English scythe into the longer, thinner, curved implement, with stiffened back, now in use."

Nov. 19, 1885

Start of Iron Ships

The eighth volume of the Census Reports of 1880, in its chapter upon the shipbuilding industry of the United States, gives an interesting sketch by Henry Hall of the origin and development of the practice of employing iron in place of wood in the frames and outer planking of vessels — a topic in reference to which there is no little inquiry and dispute. Over 80 years, it seems, have elapsed since the first iron vessel was built, this being a little canal-boat with a wooden frame and bottom and sides of boiler iron. This little boat was used on a canal in England. Its lightness and buoyancy attracted much attention, and led to the construction of other boats of the same class. The first iron steamer was manufactured at Horsley, England, in 1821, put together in London, and sent to France for use. In the 10 years following a number of small iron steamboats were built for companies in England and on the Continent. Packets for use on the English coast were next built and, finally, in 1838, sailing vessels of from 200 to 300 tons register were built at Liverpool and elsewhere for the foreign trade. Two years later the iron shipbuilding industry was largely developed, the opinion having gained acceptance that, in England, at least, for all large tonnage it was cheaper to build of iron than of wood. The



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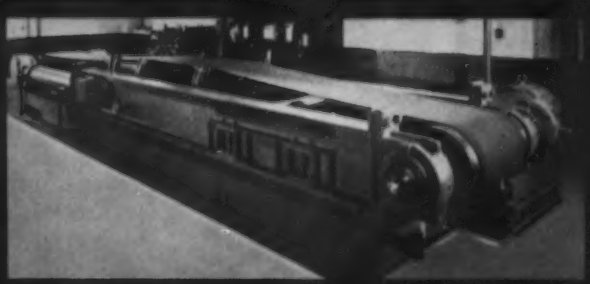
1921 . . . concrete aggregate was first conveyed from gravel to pouring locations by long distance conveyor belt specially engineered by Manhattan for construction of the Stamford, Conn., Water Works Dam.



1924 . . . advanced engineering methods first made practical the conveying of construction materials from native sources over rough terrain with nearly 5 miles of belt, during construction of the famed Wanaque Reservoir Dam in North Jersey.

1927 . . . Manhattan's Homoflex conveyor belt duck development . . . the first departure from "boardy" conventional belt ducks and the first major structural improvement in conveyor belt design. This was followed by the Homocord development, another milestone in conveyor belt construction.





1948, 1951 . . . world's largest precision conveyor belt press and largest test machine expand facilities and improve belt design at Manhattan's Passaic, N. J. plant.

1953 . . . R/M engineers introduce another exclusive development, the "XDC" cover, which protects R/M heavy duty conveyor belts against wear, abrasion, cuts, tears and prolongs belt life to a degree never before attained.

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light weight and longer life of the iron vessel, as well as the fact that it costs from $10 to $20 per ton less than the wooden vessel, have gained for the former such a decided preference that in England the production of wooden tonnage has steadily declined year by year, until in 1884 it has virtually come to an end. It may be added that the first large iron steamship and the first large ship in which the screw propeller was used was the *Great Britain*, which made her first voyage from Liverpool to New York in August and September, 1845. Her designer was Brunel, who was so well known to fame as having constructed the *Great Western* in 1838 and the *Great Eastern* in 1859.

First American Ship

The first iron vessel put together and used in America was the *Codorus*, which was exported in pieces from England in 1825, and first employed on the Susquehanna River, in Pennsylvania. In 1835 there were five iron steamers in use on the Savannah River, built, it is supposed, in the North. In 1836 an iron steamer of 600 tons was launched at New York, and in 1838 another was built at Pittsburgh. In 1841 Boston and in 1842 Philadelphia added their names to the list of producers of this class of vessels. Baltimore's record begins, it is stated, with the new type of express steamer launched by Ross and Thomas Winans in 1858.

Feb. 5, 1885

Kentucky Iron

Clear Creek Furnace, Bath County, has now 3000 cords of wood cut, and will be ready to commence making iron about the 1st of July.

It is expected the Estill Furnace will be put in blast about the 1st of May. This furnace was built in 1831.

Apr. 29, 1880

Mechanizing the Farm: A 1925 Prophecy

You are driving down a country road one sunny morning in 1950. You stop beside a prosperous farmhouse and clamber out in search of water for the radiator's innards.

Behind the house is a huge steel shed similar to a hangar—but there are no fragile planes in that shed; only a dozen huge-wheeled, snub-nosed machines which would find it hard to leave the ground save under the persuasive influence of a hoist.

You approach one of the overalled mechanics who is busy with a spanner tightening various parts of a tractor.

"Where's the farmer?"

"I'm the farmer," replies he of the wrench. "What can I do for you?"

Back in 1925 you might have been surprised to find a son of the soil looking like a machinist, but in 1950 you are not astonished. The machinist has come to the farm to stay. Farming is a mechanical industry in 1950.

Farm Use of Power

If you think that such a view of the future is exaggerated, recall the changes which have taken place in the last two generations. Sixty years ago the power for farms was furnished by animals. Horses and mules and oxen still help the farmer. But their proportion of the total power used on farms is less each year. Today more than half the primary power on our farms is mechanical. The beast of burden requires a machinist more often than a veterinary.

Stackers and Diggers

Farms use more power than all our mines and factories. And in two short generations, more than half this enormous transformation has been effected. Nor does it stop at the power phase of agriculture. From hay stackers to potato diggers, the whole field of agriculture is being revolutionized—mechanized. In 1850 the production of agricultural implements was less than $7,000,000. Last year the output of farm machinery, including tractors, passed the $300,000,000 mark.

Dec. 10, 1925

May Use Electricity

The Mahoning Valley Iron Co. are considering as to the advisability of introducing the electric light into their mill.

Apr. 15, 1880

Texas Imports Steel

For some time imports of foreign steel at the ports of Galveston and Houston have considerably exceeded those at any other ports in the United States, and the result is that Texas and the Southwest is one of the most difficult sections of the country as a market for American steel.

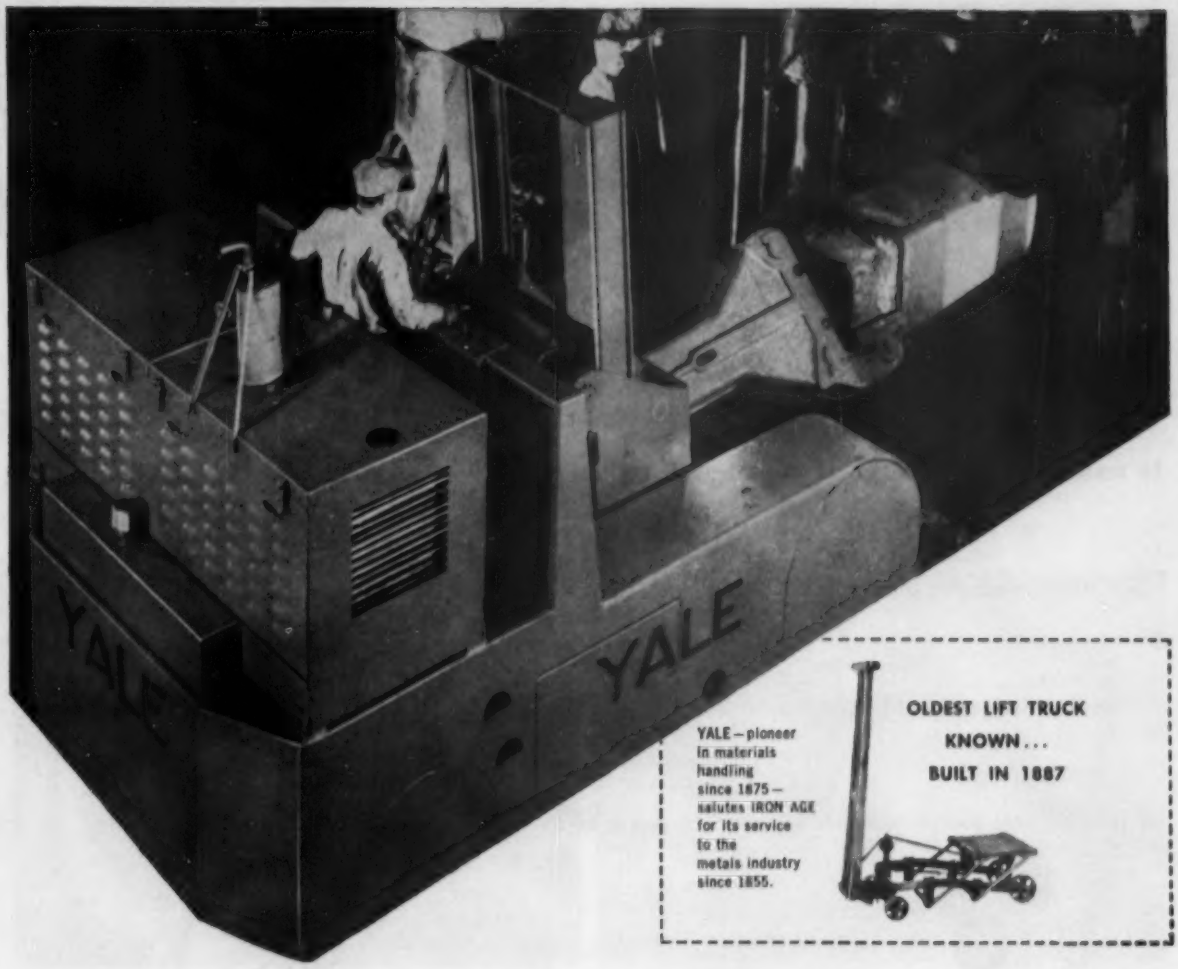
While the total amount of foreign steel coming in is not large in relation to the total consumption of the Southwest, the imported steel has had a disturbing effect on prices. Indications are that imports of foreign steel will increase during the next year.

Nov. 19, 1925

ACKNOWLEDGMENT

In addition to those mentioned in the text or in photo credits, the editors also want to thank the following for their help in preparing this section:

J. R. Bright, Harvard Univ. Grad. School of Bus. Admin.; L. W. Shea, The Materials Handling Institute; Ajax Flexible Coupling Co., Inc.; American Hoist & Derrick Co.; Bassick Co.; Buda Co.; Caterpillar Tractor Co.; Chisholm-Moore Hoist Div.; Cleveland Crane & Engineering Co.; Faultless Caster Corp.; Link-Belt Co.; Macwhyte Co.; Mansaver Industries; Revolvator Co.; Richards-Wilcox Mfg. Co.; John A. Roebling's Sons Corp.; Ruger Equipment Inc., Sage Equipment Co.; Silent Hoist & Crane Co., Inc.; Whiting Corp.



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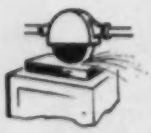
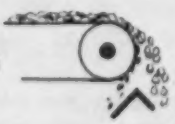
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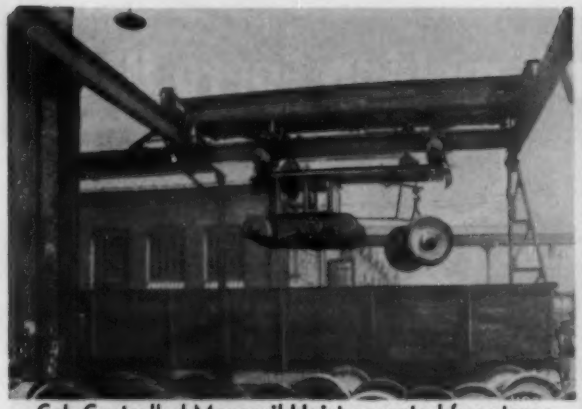
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In addition, Stearns builds many other types of magnetic equipment. We will be happy to send literature on any of the magnetic units mentioned above — or answer specific questions on the use of magnetic equipment in material handling, power transmission, or product purification. Write, wire or call us or see your Stearns representative.

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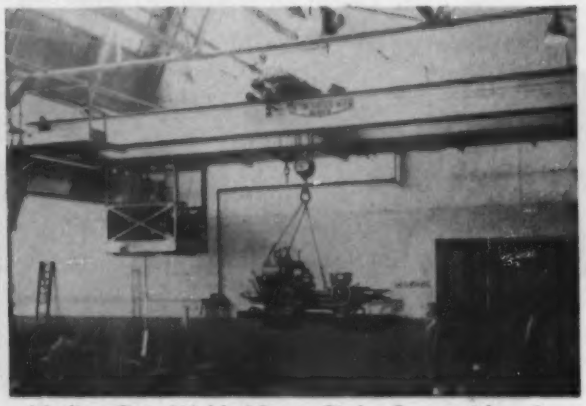


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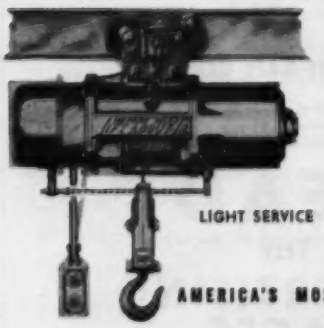


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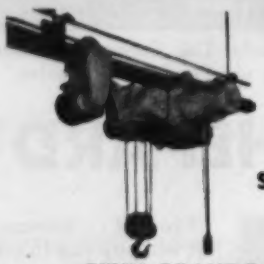
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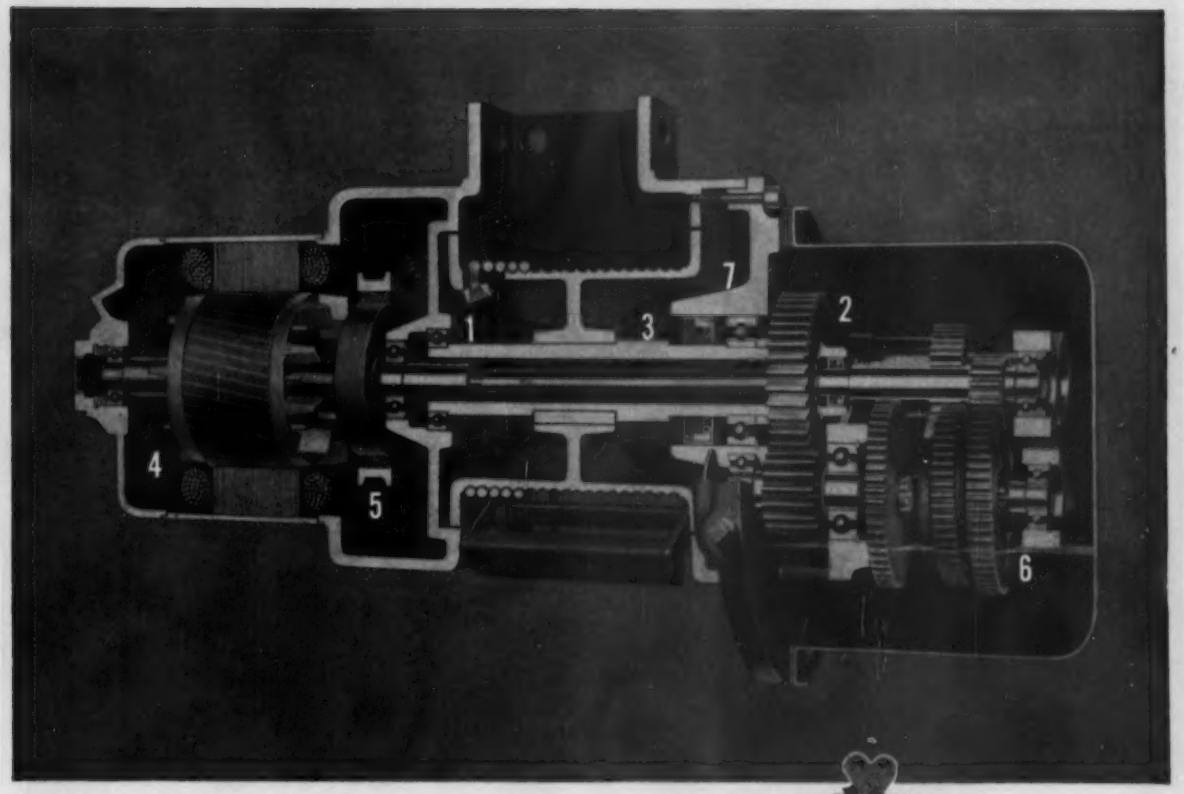
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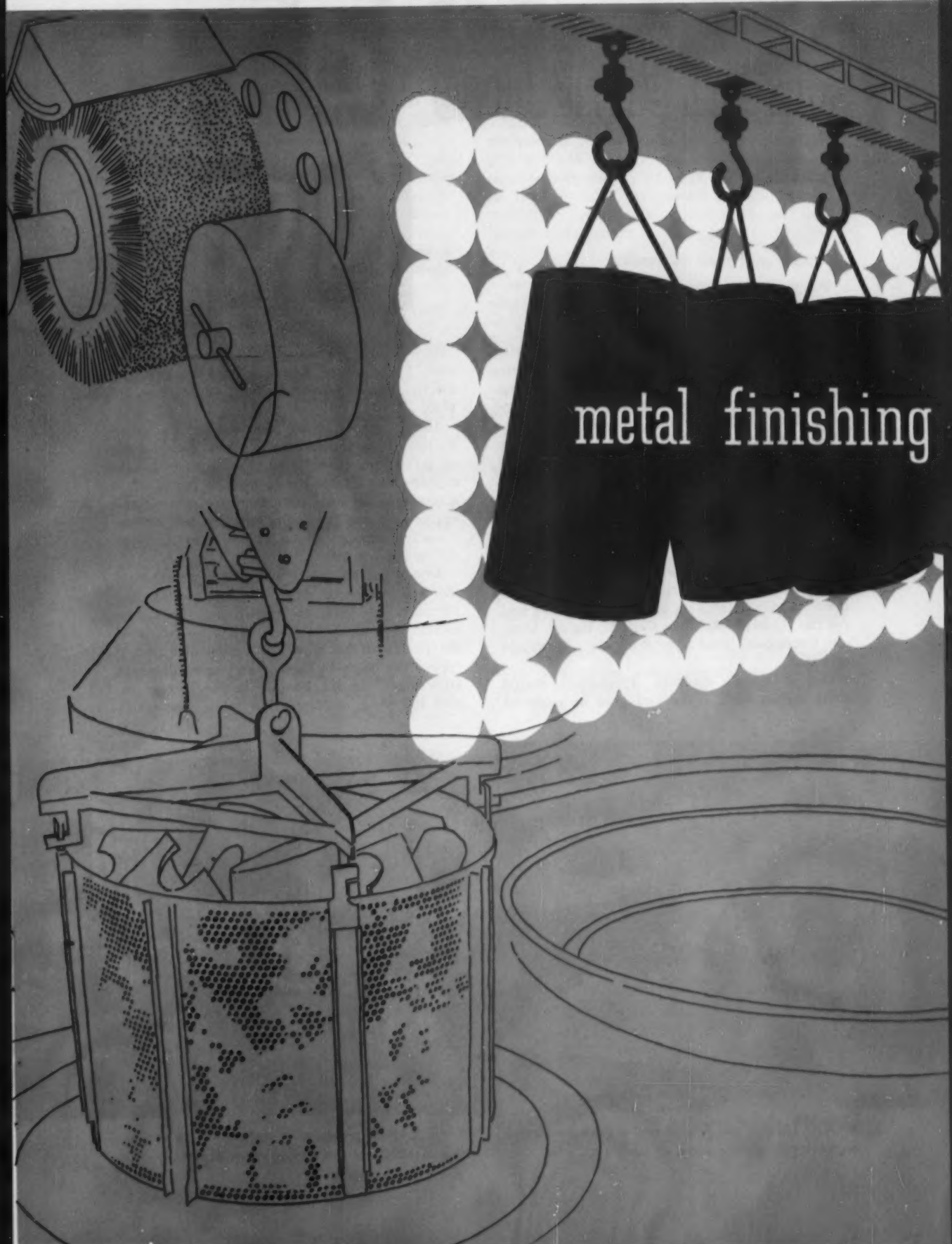
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100 YEARS OF METALWORKING



METAL FINISHING 1855 1955

OBJECTS uncovered by archeologists give some indication as to how long metal finishing has been practiced. The Egyptians coated basic metals with silver and gold about 4000 years ago, probably by dipping them in a molten metal bath or bonding foil onto the surfaces by hammering. Yet, virtually every process in commercial use today had its origin in the last century and a half.

Electrodeposition of metals started shortly after Allesandro Volta devised an "artificial electrical organ"—better known as the voltaic pile or cell. This discovery, announced in 1800, made it possible to store electrical energy for the first time. It soon became an important research tool for the chemist. Men like Carlisle, Henry, Davy and Cruikshank used it to study the electrolysis of water.

One of Volta's students, Brugnatelli, coated some metals with silver and gold as early as 1802—strictly for decorative purposes. And in 1803, Berzelius and Hisinger described how they electrolytically deposited silver, copper, iron and zinc.

Until 1830, scientists searched out the possibilities of electrodeposition. Then, Jacobi made an interesting observation. While removing the copper deposit from the cathode, it peeled off in a layer—an accurate reproduction of the cathode surface. It was the beginning of a new process —electroforming—which gained great popularity in the late 1800's.

Among the scientists who were prominent in the pre-commercial days of electroplating was Faraday. In 1833, he worked out the fundamental laws of electrolysis. When he published the results of his work, he commented that it "opens the doors to further and more abundant knowledge." It did, because in the 10-year period following, electroplating went commercial.

Hanson-Van Winkle-Munning Co.



WOOD TANKS, gas fixtures and shunt-wound generator typify plating room of early 1900's.



HAND LABOR prevailed in metal finishing operations of 1800's as this buffing room depicts.

Faraday made other important contributions to the young industry. An important one was his discovery of electromagnetic induction, also in 1833. By rotating a copper disk between the poles of a permanent magnet, he produced the first generated electric current. This development layed the groundwork for developing the dynamo. Although it had great influence on the industrial growth of electroplating later, ways of improving the voltaic cell seemed to hold more promise at the time.

One of the chief difficulties with the voltaic cell was cathode polarization. It caused current to drop off sharply with continued use. Smee worked on the problem but it was Daniell who, in 1836, developed a cell capable of delivering a substantially constant flow of current. Instead of polarization, the action at the cathode in this cell was the deposition of copper from an acid sulphate solution.

The Daniell cell gave electroplating the impetus it needed. In the next few years, a number of metals were electrodeposited. G. R. Elkington and Barratt patented a process in 1838, using a single cell, to deposit zinc. The advent of hot-dipped zinc coatings in 1837, which afforded effective protection to iron, forestalled further development of zinc plating until 1855 when Watt patented a cyanide zinc solution.

Platers turned to sulphate bath

Even this development did little to commercialize zinc plating. It was not until after 1890 that some zinc plating was done from a sulphate solution. A most important factor in promoting zinc plating on a commercial scale was the improvement in refining methods. In addition to providing zinc of higher purity, solutions developed from those used in the refining process led to coatings with greater ductility. About the time of World War I, electrodeposition of zinc became well established.

The greater use of zinc affected the electroplating industry in still another way. In the refining process, cadmium became available in greater quantities. This prompted the revival of the process in which Russell and Woolrich had used a double cyanide solution in 1849. From 1920, cadmium deposits became widely accepted for their effective protection of steel surfaces.

Surgeons played prominent roles throughout the history of plating. J. Wright was one of these. In 1840, he successfully deposited silver from a bath consisting of a silver salt dissolved in a potassium cyanide solution. The Elkingtons acquired the rights to this development and paid Wright royalties based on the amount of silver deposited.

Plating of copper and gold from cyanide solutions had also begun about the same time. Brass plating, done by de Ruolz in 1841, was patented by Russell and Woolrich in 1849.

The industry grew at a fast pace. The Elkingtons, recognizing its commercial potential, acquired the rights on virtually every major development on silver and gold plating. In addition to Wright's development, they secured the rights to Leeson's patent on applying mercury to certain basic metals to facilitate silver plating, and Millward's patent of 1847 on bright silver plating from a bath containing carbon disulphide.

Isaac Adams was another doctor who gave up the medical profession to devote the remainder of his lifetime to electroplating. His name became well known for his work on nickel plating. In 1869, he obtained patents on the process, methods of preparing pure nickel salts and casting the nickel anodes.

Effects of impurities studied

Actually, Adams had done some nickel plating satisfactorily in 1860. From 1862 to 1864, he was in Europe studying medicine and chemistry—mostly chemistry under Dr. Bunsen. After his return, he again took up nickel plating. He used the same bath composition as he had used in 1860, but this time the results were not the same. This led him into a study of the effects of impurities in the bath.

After extensive experimenting, he overcame his difficulties and within a short time started to commercialize the process by organizing the Boston Nickel Plating Co. The process spread rapidly both here and in Europe. In addition to the basic patents, Adams acquired ten others on plating. One of these was on cobalt plating and another on nickel plating with a single salt which he did not commercialize because bath control was more difficult than with the double salt solution.

Electroplaters were still using the double nickel ammonium sulphate solution for most work in the early 1900's. Plating of nickel from

Mesta Machine Co.



STEAM-DRIVEN pickling machines built in 1899 are still used for plates, bars and forgings.

hot high-speed baths was proposed by Foerster in 1897 and Levy in 1906, but it was not until 1916 when Watts described his process that nickel plating spread with even greater rapidity. Expansion of the automobile industry was an important contributing factor.

Chromium plating was in the development stage for many years before a commercially workable process could be found. Junot tried using chloride solutions in 1848, Bunsen published a paper in 1854 on chromium plating from trivalent sulphate solutions, and Geuther reported in 1856 on what were probably the first chromium deposits from a chromic acid solution. All of these findings resulted from studies for purposes other than applying chromium as a finish coating.

Almost 50 years of continued effort followed. In 1905, Carveth and Mott told of their experiments with chromium plating. Carveth was joined later in his work by Curry. Their work must have given them some encouragement because they predicted that chromium, as a plating material, has "a great future before it." Sargent continued this work for a number of years afterward.

Despite this, no truly workable process was developed until Fink and Udy, working independently, discovered the principles for obtaining good control in chromium plating. They applied for patents in 1924, and within a few years the process came into widespread use here and abroad.

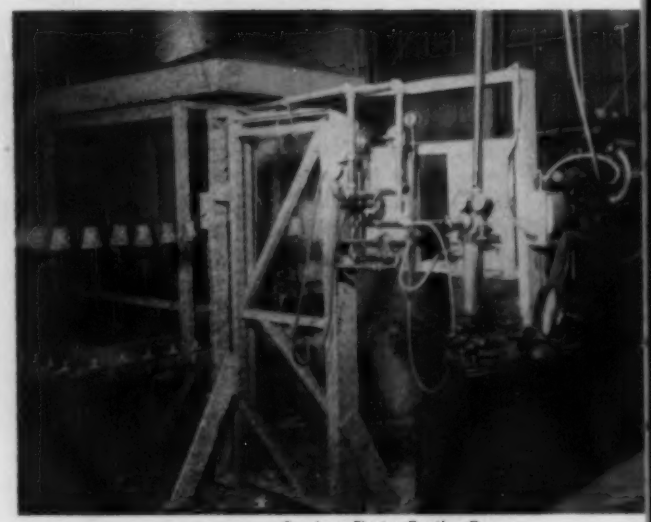
Early platers lacked equipment

Commercial plating in the last century and the early years of this century was done under extremely difficult conditions. Chemicals for solution makeup lacked purity and anode composition left much to be desired. Bath regulation was usually by "rule of thumb" and instrumentation for measurement of current values was used in very few shops. Measurement of acidity with the pH scale had not come into practice until 1916.

Power supply equipment presented another problem to the early plater. Woolrich invented a magneto-electric machine in 1842, but few shops could afford such equipment. Even those that could, used the machine chiefly as an alternate source of current to the cell.

Wilde improved on the dynamo in 1866, and in 1874, Edward Weston built a low-voltage generator for A. Van Winkle. It was of the shunt-wound type and was used by platers for about a quarter century before the compound-wound generator first appeared. Although generators gradually replaced batteries, many shops still used batteries in the early 1900's.

Many outside factors had influenced the expansion of plating. For instance, processes for plating palladium and rhodium were the results of developments in electrorefining. Originally, plating of these metals had little or no practical value but it marked the first time these metals were electrodeposited.



Ransburg Electro-Coating Corp.

EARLY electrostatic spray units used X-ray transformers. This was first production setup.

Large-scale production of aluminum was another influencing factor. The advent of aviation stimulated production so that it became one of our more abundant metals. Various surface treatments were proposed to increase its corrosion resistance. In 1924, Flick obtained a patent on chromic acid anodizing which opened an entirely new field for electrolytic treatment. Eight years later, sulphuric acid anodizing made its debut.

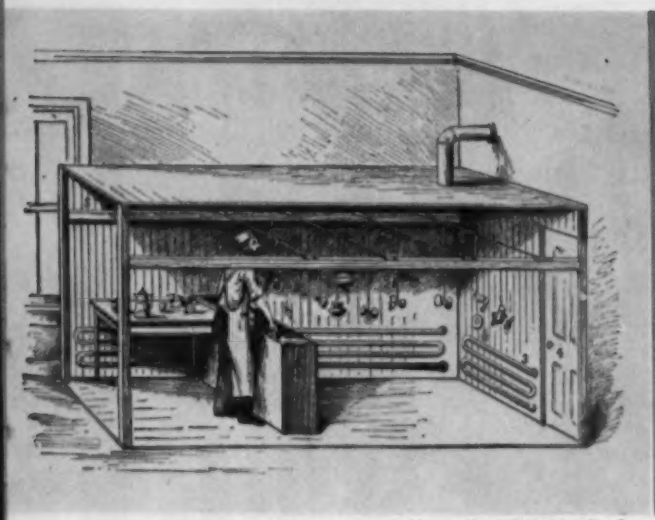
Plating kept pace with all changes in the industrial pattern. When zinc and aluminum diecastings came into commercial use, new plating solutions were developed. And in 1897, when American industry sought faster means for plating mass-produced small items, plating suppliers introduced the plating barrel.

Cleaning presented a problem

Mass-production also created a need for equipment to plate larger items. Broderick received a patent in 1906 on a plating conveyor, but it was not until 1922 that the A. P. Munning Co. introduced the first fully automatic plating conveyor for commercial use. This model was based on the Broderick patent.

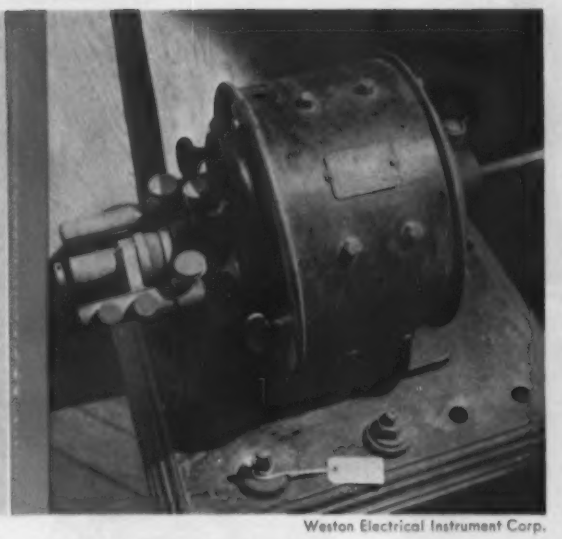
As the industry grew, it also had to devise faster and more effective methods of cleaning the work. Until 1900 and shortly thereafter, the scrubbing table with acid jugs, rinse water, soaps, pumice and potash was still in widespread use. The workman controlled the solution, according to Watts, by "simply dipping the tip of his finger in the solution and applying it to the tip of his tongue. When it fails to tingle or 'bite' the tongue, the solution has lost its caustic property."

Electrolytic cleaning in an alkaline solution



Hanson-Van Winkle-Munning Co.

LACQUERING was an important phase of production in 1800's—yet it occupied a corner spot.



Weston Electrical Instrument Corp.

FIRST GENERATOR built by Weston in 1874 was a big step forward in replacing voltaic cells.

was introduced in 1898 and gradually began to replace the use of caustic solutions. In the early 1900's a few plants had adopted barrel cleaning, using a mixture of sand, leather and alkali. Spray and paddle-type washing machines also started to appear at this time.

About 1925, the alkaline phosphates were used to formulate more efficient cleaning compounds. To supplement conventional cleaning practice, metal finishers started to use chlorinated solvents in about 1928 as replacements for petroleum-base solvents to remove heavy greases and buffing compounds.

The scrubbing table became a rare piece of equipment in the plating shop by 1930. The aluminates, borates and metasilicates began to find wider use, and by 1935, alkaline silicates of the orthosilicate ratio appeared on the market. Many specialized cleaners were also introduced during this period. By 1940, cleaning had become a well mechanized operation.

The period around 1900 might well mark the beginning of a new era in plating in another respect. Until this time, the plater's chief tools for controlling the composition of the plating bath had been litmus paper and, in some cases, the Baume hydrometer. Rheostats, ammeters and voltmeters were just coming into wider use.

Progress in organic finishing had also kept pace with the needs of industry. In the early days of the automobile industry, for example, an organic finish took two weeks to apply by hand labor. The time required was estimated at 500 to 600 hours per car body. Yet, after about a year's exposure, the body usually needed refinishing. Lead and linseed-oil paints, japan colors and resin varnishes were the principal finishing materials of those days.

A major advance in organic finishing was the introduction of low-viscosity cellulose nitrate which gave a greater solids content to lacquers, thereby reducing the number of coats required. Many other materials have improved automobile finishes by at least a few hundred per cent.

At first, the industry accepted hand brushing as a carry-over from the carriage trade. This was followed by mechanized brushing in which the paint was fed to the brush by pumping. This technique lasted only a short time, and during World War I, the spray gun came into use for the first time. In more recent years, electrostatic spraying came into use, overcoming the problems attendant with overspray.

Another highly important aspect of metal finishing has been the use of phosphate coatings to improve paint adhesion and corrosion resistance of the metal. The value of phosphatizing had been known for many years, but it took the work of T. W. Coslett to bring about the modern concept of phosphatizing. He obtained a patent on his process in 1906 and called it Coslettizing.

Several patents obtained by W. H. Allen between 1915 and 1918 paved the way for commercial phosphatizing in the United States. It was promoted by Parker Rust Proof Co. and became known as Parkerizing. This process, based on the manganese phosphate baths, was used extensively during the 1920's and early 1930's.

Phosphatizing time shortened

A major advance in phosphatizing can again be attributed to the work of the Parker Rust Proof Co. In 1933, it obtained a patent based on the use of oxidants in the phosphatizing bath. This development did two things: (1) by depolarizing the cathode, processing time was shortened to only a few minutes, and (2) it oxidized soluble ferrous iron which precipitated as insoluble ferric phosphate and thereby stabilized the solution.



Hanson-Van Winkle-Munning Co.

BATTERY of sixty generators supplies power for Oldsmobile's huge bumper plating installation.

METAL FINISHING...

METALLIZING GUN melts and sprays hot metal on shaft to improve its corrosion resistance.

Metallizing Engineering Co.





METAL FINISHING today demands a scientific approach. More aptly, it may be termed a science in itself. Its requirements are so complex that the research laboratory has become an important adjunct to the modern finishing plant.

Recent progress in metal finishing has generally been in the refinement of existing processes and development of specialized materials and equipment. Compounds are formulated for very specific results—always with the intent to improve quality and speed processing.

Plant equipment and layout are establishing a trend approaching the near ideal in working conditions. Even today, they are in striking contrast to the shops of 50 years ago. Many cleaning, plating and painting departments have been integrated with manufacturing operations. No longer do they occupy a dark corner or basement of a shop to hide their unsightly appearance and minimize the effects of noxious or corrosive fumes.

The health and safety of employees are prime considerations in the modern finishing plant. Efficient exhaust systems expel unpleasant and hazardous fumes and draw air through filters, often making the air inside purer than outside. Corrosion-resistant lighting fixtures are spaced and positioned to avoid eye strain. Ceramic tile walls improve appearance and reduce cleaning problems. Flooring of special materials and design resists chemical attack, reduces dampness and increases safety.

Equipment is compact, enabling high production rates in relatively small areas. Although often complex, it is designed for efficiency, dependability and ease of operation. Handling devices, often considered accessory equipment, now form an essential part of the finishing line. In many shops, their use has virtually done away with all manual handling. Ingeniously designed conveyors, timing mechanisms, transfer devices and scores of other pieces of apparatus rout an endless chain of work through precise finishing cycles.

Control of solutions is no longer done by the "taste" test. The laboratory is the hub of activity in the modern shop. That's where the efficiency of plating and cleaning solutions is checked, additions determined, faulty work analyzed, and tests for hardness, ductility, brightness and thickness performed. An impressive array of instruments is in constant use, giving fast and accurate checks on those factors which may affect the properties of the finish.

Rectifiers, generators, pumps, filters, valves and the many other devices essential to plating are remote or concealed from the operating area either to protect them from corrosive attack or to provide more working space. Yet, they are readily accessible for adjustment, maintenance or repair. The power supply is regulated from a centrally located panel.

Behind the physical aspects of the modern plant are the many developments which collectively make metal finishing such an exacting science. Nickel plating serves as a good example. There are at least nine nickel plating baths, plus numerous modifications. Each has particular characteristics; each produces deposits with specific properties. Thus, nickel plating has uses in many fields—engineering, printing, decorative. There are bright baths and leveling baths, and baths to give wide ranges in hardness and stress. Nickel plating can be described as virtually an industry within an industry.

Introduction of bright nickel plating by Schlotter in 1934 was a milestone in the life of the industry. He patented two baths—a sulphate and a chloride. Since then, many refinements have been made in the operating characteristics of the solutions. The baths now have greater stability, wider operating ranges, simpler control and better leveling action.

Preplating with a low pH nickel strike has also improved the adhesion of bright nickel deposits. Another process which increases adhesion of the nickel layer involves the treatment of parts anodically in a special nickel solution. The parts are then treated anodically and cathodically in a cyanide-carbonate bath.


Pangborn Corp.

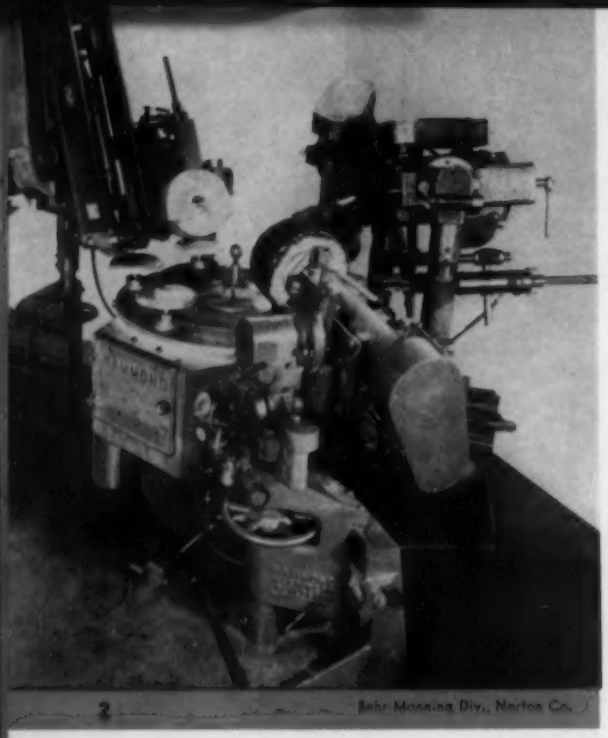
Nickel plated directly on aluminum

Still another process plates nickel on aluminum without the need of an intermediate bonding material such as copper. Deposits can be made either on raw or anodized aluminum. Coatings are claimed to be ductile, pore-free and stress-free, and their hardness varied from 150 to 550 Vhn. The nickel can also be deposited with a soft, resilient layer against the aluminum and a hard, abrasion-resistant outer coating.

In recent years, nickel plating from a sulphamate solution has attracted considerable interest. Sulphamic acid, first produced by Berglund in 1878, did not become available commercially until shortly before 1940. M. E. Cupery obtained a patent in 1943 on plating from various sulphamate solutions. However, little was done with the process outside the laboratories until it was introduced to the electrotyping trade in 1950. Since then modified solutions have been developed and uses for the process have been found in the automotive, aviation and other industries.

Deposits from nickel sulphamate solutions exhibit certain advantageous properties for engineering applications. One of these is the low compressive stress which gives parts greater resistance to impact loading. Another advantage is the ability to vary the hardness of the deposit during plating. Its use on printing plates has increased press runs up to 50 pct.

Electroless plating is another process which has extended the use of nickel as a protective

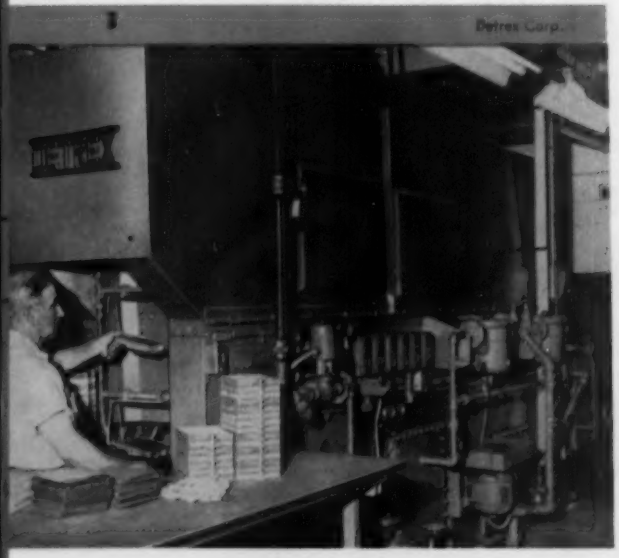


2 Behr Manning Div., Norton Co.

1 DIECAST cabs for toy trucks are grit blasted for painting at the rate of 1000 per hour.

2 SANDING and polishing machine, designed for flexibility, moves work through automatic cycle.

3 ULTRASONIC cleaning machine carries work through cycle. Sound waves scrub parts.



3 Detrex Corp.

coating. First developed at the National Bureau of Standards by A. Brenner and G. Riddell in 1946, the process has been promoted commercially by a number of firms in recent years. Nickel coating by this process is more costly than by electrolytic deposition, but plating by chemical reduction offers certain advantages not attainable electrolytically. Rather than replace, it has supplemented electrolytic deposition.

Since plating by this method is achieved chemically, there are no problems with the throwing power of the bath. Deposits form on all immersed surfaces — even on intricately shaped objects. As-deposited, their hardness is about 500 Vhn, but this value can be increased by heat treatment. Deposits can be applied to ferrous and nonferrous materials as well as to nonmetallics. Cobalt has also been deposited by chemical reduction but application of this process has not yet attained commercial importance.

Some electroless nickel barrel plating has been done commercially on a limited scale. It permits plating of small parts with deep holes and recesses. Also, the tumbling action produces a somewhat brighter plate. Only plastic barrels have proved successful thus far for this purpose.

Alloy plating advances

Significant advances have been made in the field of alloy plating. Tin-zinc plating had grown very rapidly and is now regarded as a commercially established process. The coatings have excellent solderability and good resistance to corrosion. This combination of advantages makes the process particularly useful for plating electronic components which must be soldered, but frequently have an extended shelf life because of the large inventory that must be carried.

Some tin-nickel alloy plating has been done from a solution containing stannous chloride, nickel chloride, sodium fluoride and ammonium bifluoride. Improvements have been made in bath composition and at least one commercial installation is now in use. Further work is being done to improve brightness of deposits so that finishing operations can be eliminated. Pitting has caused some difficulty, but the process can be applied satisfactorily with a reasonable degree of control.

Until recently, attempts to plate on titanium by conventional techniques have not been successful because of its highly active surface in aqueous solutions. A method has been described for applying an adherent deposit of copper on titanium by first anodically etching the surface in a nonaqueous solution containing ethylene glycol and a zinc salt. The etch prepares the surface so that the deposit interlocks mechanically with the basis metal.

An interesting switch in electroforming has been the deposition of finishes which are as much as 58 pct porous. Copper and nickel tubes of 1-in diam have been electroformed over steel mandrels coated with graphite. Both liquids and gases can permeate the electrodeposits. The pore-producing action results from the addition of a dispersion of colloidal graphite to the plating bath.

New coating resists corrosion

Recent developments on other metallic coatings were equally significant. One is a process for coating steel surfaces by hot aluminum dipping. It involves preheating and fluxing the parts in a molten salt bath prior to coating. The salt bath consists of potassium chloride, sodium chloride, cryolite and aluminum fluoride. Parts coated by this process acquire good resistance to corrosion and heat.

Metallizing, which had been used primarily for decorative coating, now has many industrial applications. It is particularly useful for coating nonmetallic materials such as mica, plastic and glass in making reflectors, condensers and resistors. The process is also used to apply a conductive coating on nonconductive material for subsequent electroplating.

Three metallizing processes are well known —high-vacuum evaporation, reduction from aqueous solutions and reduction by heat. High-vacuum metallizing consists of vaporizing a small amount of metal by heating it under a vacuum of about 10^{-5} mm of mercury. Vapors are emitted in all directions, quickly coating the objects in the vacuum chamber. Most commercially used metals can be applied by this process.

Metallizing by reduction from aqueous solutions is used chiefly for applying silver, copper, gold, antimony and certain alloys in making reflectors and mirrors. One advantage of the process is the simplicity of the equipment used. The process is specially suitable for depositing conductive coatings on nonconductive materials for subsequent electroforming of intricate shapes.

The reduction by heat process is limited to use on glass and ceramic materials which can stand the high temperatures required to reduce the metallic compounds. The compound is applied in paste form, then dried and fired.

Gas plating, which originated with Ludwig Mond in 1890, continues to plague researchers. Although production lots have been coated by this process, difficulties in application techniques have hindered wider use. The process shows promise since it has many inherent advantages in its favor.

First, any metal, the compound of which can be vaporized and has a decomposition temperature, can be deposited on metals as well as on some nonmetallic materials as plastic, ceramics and paper. Basis metals of different composi-



4 BELT SANDER operates automatically in grinding welds 400 pct faster than by manual grinding.

5 RACKS of costume jewelry slide into chamber to be metallized by vapor under high vacuum.

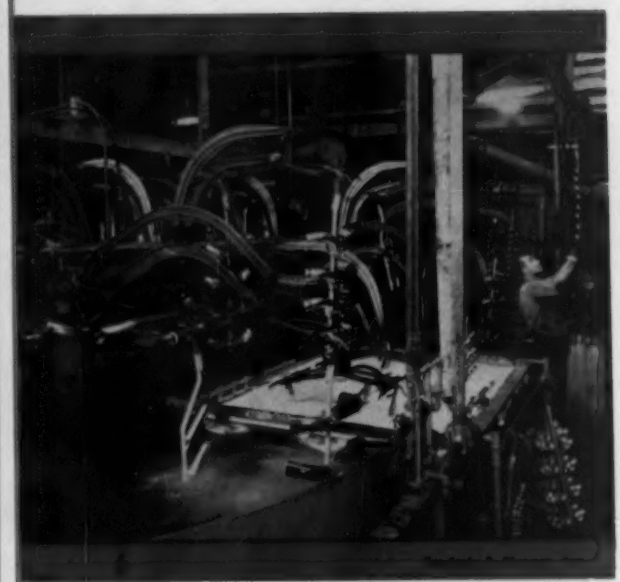
6 MECHANICAL ARMS of a fully automatic plating machine take parts through a precise cycle.



tions can be plated simultaneously. Large objects have been plated at the rate of 1 mil per minute, and endless fibers of glass, more than 20,000 at a time, can be plated at 100 fpm.

Chemical surface treatments have found greater use in an increasing number of industries. Chromate treatments, for example, are simple and inexpensive to apply, yet afford good corrosion resistance and serve as bases for organic finishes on a number of different metals. Among the more recent developments in this field are bright finishing of zinc die-castings and the treatment of silver to prevent tarnishing. Chromate treatments have also been effective on magnesium surfaces, to retard corrosion and improve paint adherence.

Chemical oxide coatings on aluminum, which are from 100 to 200 times as thick as natural oxide films, offer good corrosion resistance and excellent bases for organic finishes. Solutions for the process are of two types—inhibited alkaline solutions, and weak acids which form complex ions. In recent years, these coatings have grown in commercial importance.



Phosphate coatings, too, have been used more widely and in new and different ways. In addition to being effective in improving paint adherence, the coatings are used with rust preventive and lubricating oils to obtain corrosion resistance of parts being processed. They are also used with organic lubricants in cold deforming operations.

Cleaning processes specialized

Cleaning of castings is about as old as the casting process itself. Shortly after the turn of the century, cleaning methods were about as crude as the casting methods. One author said, "The cleaning of castings is a simple operation in an iron foundry where common castings are made; any worker is fit to trim a coarse casting or scour it. The first is done by means of a chisel or sharp hammer, the latter with dull, coarse files, which have been used and rejected by machinists."

By contrast, processes are now in use for cleaning and finishing virtually every type of product at a very low unit cost and high production rate. Some of these processes include: sand blasting, wet sand blasting, tumbling in various sorts of media, shot blasting, metal grit blasting, liquid blasting, ultrasonic cleaning and a variety of descaling processes. Notable, too, has been the increasing use of diphase and emulsion cleaners and electrolytic alkaline cleaning for the effective removal of heavy soils.

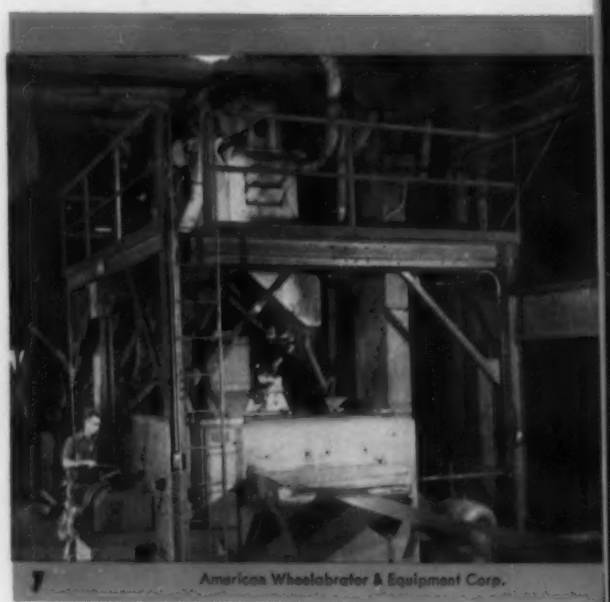
Ultrasonic cleaning, which until recently has been used almost exclusively for thorough cleaning of small parts, is now used on castings weighing as much as 150 lb. Conveyorized setups have been installed in some plants to eliminate manual loading and unloading. Sonic energy emitted by barium titanate transducers

has a penetrating cleaning action which effectively removes soils from the very inner recesses of intricately shaped objects. Even more recently, sonic energy has been put to use in soldering operations to break up surface oxides, thereby producing strong joints—without the use of flux.

Not only must today's cleaning equipment do an effective and efficient job, but it must also operate at a rate commensurate with production. A shot blasting unit in a stainless steel mill is a typical example. It cleans stainless strip up to 39 in. wide at rates of 30 to 75 fpm, or an average of 17 tons per hour. As the strip passes through the blasting cabinet, the top and bottom sides are cleaned simultaneously. Moreover, the equipment occupies about half the space previously required and five men now do the work which formerly required 24 men.

With high-speed finishing methods, the demands of materials and equipment become increasingly stringent. They must be effective and dependable, otherwise many of their benefits are lost. To check cleaner effectiveness, fatty acid-type soils tagged with radioactive tracers were applied to metal specimens, then subjected to treatment in numerous cleaning solutions. After cleaning, rinsing and drying, the specimens were checked for radioactivity with Geiger counting equipment.

This test method is simple in principle, yet it is sensitive and can provide quantitative measurements without the limitations of other testing techniques. Although it is still a laboratory tool, the method shows promise of becoming a shop procedure.



American Wheelabrator & Equipment Corp.

Porcelain finishes gain importance

Several new developments in porcelain enameling have given these finishes added importance, both commercially and industrially. A recently developed enameling method eliminates the need for a ground coat. One of the features claimed for the process is that it can be applied to many non-premium cold-rolled grades of steel. Surface quality is said to be comparable to that of conventional porcelain finishes, yet the thinner coating has greater resistance to heat, impact, thermal shock and torsion.

Use of the high-temperature porcelain enamels has been extended to a number of industrial applications. They have substantially lengthened the service life of parts subjected to corrosion and abrasion at elevated temperatures. Their use has been particularly effective for jet engine parts, combustion chambers, equipment subjected to contact with sulphuric and muriatic acids, and many other such uses.

In the organic finishing field, hot spray painting has gained wider acceptance. Heating of finishing materials had been tried before World War II, but because adequate equipment

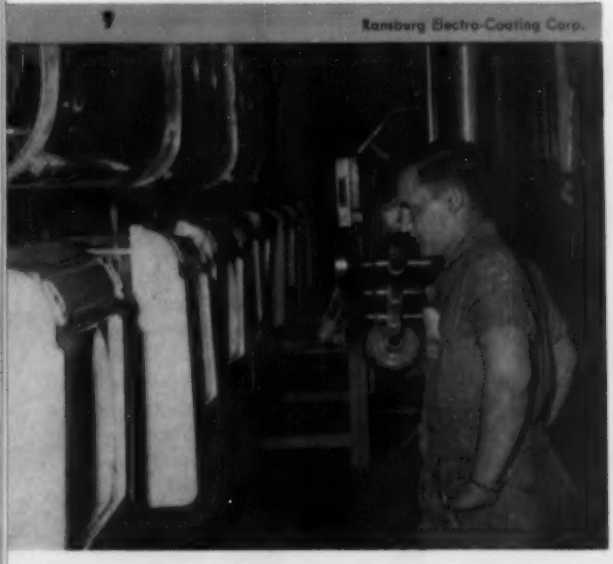


Westinghouse Electric Corp.

7 DESCALER in a continuous line mechanically processes up to 17 tons of strip per hour.

8 PAINTED transformer tanks dry quickly as they pass between banks of infra-red lamps.

9 ELECTROSTATIC spray coats washer panels at Whirlpool plant as they advance at 12½ fpm.



Ransburg Electro-Coating Corp.

was lacking, the process did not attain widespread use. Since then, improvements have been made both in equipment and spraying techniques.

Three types of hot spray applications are in general use; air atomization of heated paint, airless hot spray, and steam spraying. With most organic finishing materials, viscosity decreases as temperature increases. As a result, better uniformity of the finish is achieved and the number of rejects reduced. Very often, there is also a saving of material. Another important advantage is that since less solvent is needed in hot spray materials, solids content can be increased. From the practical viewpoint, this results in better coverage with fewer coats.

One of the big problems in spraying has been the waste of material in over-spray. This problem has been largely overcome by the increasing use of electrostatic spraying. Articles to be sprayed are grounded to a conveyor which carries them into a spray zone with a grid charged to a high potential. Thus, an electrostatic field is created between the workpieces and the grid. As the finely-divided paint enters this field, the particles are charged to the same polarity as the grid and opposite to the parts being sprayed. Thus, the particles are attracted to the article being coated.

Articles to be coated by electrostatic spraying must be capable of conducting electricity. They need not be magnetic. The process saves about 50 pct in paint consumption, and in some applications this figure runs considerably higher. Usually, spraying time and manpower requirements are greatly reduced.

A considerable amount of research has been devoted recently to the treatment of waste products from metal finishing operations. This work has been approached from both the theoretical and practical viewpoints. Two objectives appear to be uppermost according to present trends—(1) to reduce the amount of waste, and (2) to conserve water.

The first objective is being accomplished in several ways. Design engineers are providing means for drippage from parts to drain back into the plating tanks, thus reducing the amount of drag-out. Another method has been through the use of reclaim rinses. Still another method has been through purification of solutions to reduce the frequency of periodic dumping.

Spray and fog rinses have helped to reduce water consumption considerably in some installations. Other setups have resorted to chemical treatment in the rinses to destroy cyanides. In many cases, air is injected into the water stream to provide more effective rinsing as well as to conserve water. Another method growing in practice is the use of valve locking devices to shut off the water supply after the work passes the rinse tanks.

METAL FINISHING...

the future

THE CHANGING PATTERN in the metal finishing industry has been one of continual growth. It promises to be one of accelerated growth in the coming years. This is not a prediction, but an estimate based on the history of metal finishing for which a sharp upward trend has already been established.

One look at the past 25 years of metal finishing brings the next 25 years into sharper focus. Today, there are more objects plated, with more different coating materials, on more basis materials, by more processes, and on a far greater scale than ever before. With each new development, this pace is accelerated so that the last 25-year period may only be a prelude of things to come.

In the past, metal finishing grew along a broad front. This growth required technical advancements in the chemistry of complex compounds; improvements in design, efficiency and speed of equipment; adequate supplies of materials at reasonable prices; and cheap, abundant and dependable sources of power. All of these factors have been considered as a team. Because of such progress, the metal finisher of today is doing a better job, considerably faster and with much less effort.

Metal finishing will continue to grow in all its broad aspects. Looking into history, it seems not too long ago (about 1800) that Volta's pile supplied the energy to electrodeposit metal for the first time. Since then, various types of batteries, generators and rectifiers have antiquated this first cell. Power supply equipment has been made highly efficient. In the past few years, current densities used in electroplating have climbed sharply. This will lead to smaller tank requirements, reductions in the sizes of plating machines, and higher production rates.

Nuclear energy may establish an even more significant trend in power requirements. Recently, the Radio Corporation of America revealed an atomic battery capable of converting nuclear power directly into electrical power. The amount of power generated was small, but the principle is practical enough to be in widespread use within a few decades.



Such batteries could conceivably supply the electroplater with power for many years with virtually no maintenance. They would also provide low-cost power since the batteries could use the radioactive waste products from nuclear reactors. Solar energy, also in the research stage, is another potential source of power for plating.

The materials outlook is another factor which can have a profound effect on the metal finishing industry in the years ahead. Metal finishers still remember the shortage of nickel which existed only a few years ago. Last year, the free world's output was close to 400 million pounds, an increase of about 50 pct in a 5-year period. This year, output is estimated at 415 million pounds. In spite of this steep increase in production, the rapidly expanding nickel plating industry seeks more.

Metal finishers have approached this problem from several angles. First, to mitigate the shortage, they have searched for suitable substitutes. None proved as satisfactory as nickel, but the search continues. Chromium-plated copper and bright white brass have served exceptionally well for interior uses, but they still have a long way to go to replace nickel for outdoor uses.

Another approach has been through the more extensive use of alloy plating to spread out the nickel supply. Tin-nickel alloy plating is already in commercial use in at least one plant and interest in the process will undoubtedly lead to greater acceptance within the next few years. Successful plating with other metal combinations has started what may be considered a new trend. Given some time, it may be a field of plating unto itself.

Still another approach is the regeneration of those metals in short supply. At present, nickel is being regenerated from scrap and converted to nickel salts on a limited scale. If the production of plated objects continues to skyrocket, it may not be too many years before regeneration becomes a widely accepted practice.

Production of synthetic metals is not outside the realm of possibility. Technology has advanced to a point where research laboratories are coming up with unbelievable achievements. Synthetic rubber, sapphires and diamonds are now realities. With this record behind them, researchers can be expected to accomplish similar feats with other minerals.

Other aspects of technology give still more hope of adequate supplies of minerals for the future. New techniques of prospecting should open new sources of supply to our speeded-up industries. Sensitive electronic instruments carried by plane can search out heretofore unexplored areas for new mineral deposits quickly, accurately and inexpensively. To metal

finishers, this may mean more metal to plate on goods produced in greater abundance.

Metal finishers have kept pace with the general trend of automation in industry. In many cases, they have lead it. Plating machines, which not too long ago were limited in design by the length and strength of a man's arm and his ability to load and unload the machine, have been made larger. It is safe to assume that this trend will continue into the near future.

Designers of plating equipment will look for ways to reduce the sizes of installations without sacrificing production. However, this will not come about until other problems are solved. Smaller installations will eventually be possible by the use of higher current densities, solution cooling devices, more conductors in less space, faster transfer mechanisms, and more air movement with smaller ducts.

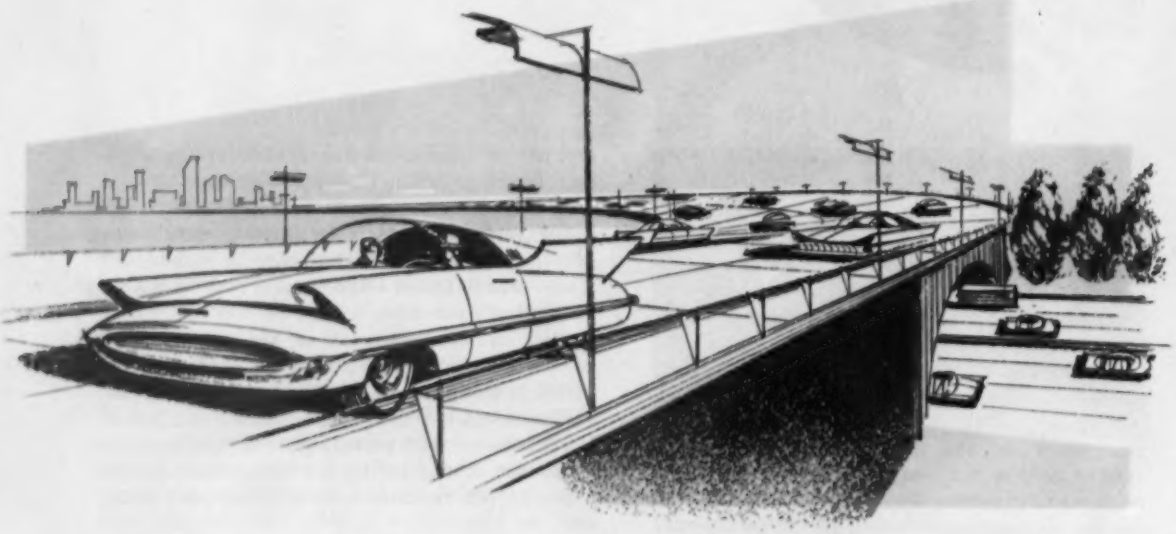
Improved uniformity, higher production, fewer rejects and reduced costs will be the principal benefits of this trend. Corrosion of metal objects, one of man's costliest enemies, is certain to get increasing attention. As processes, techniques and equipment are improved, the application of thin protective and corrosion-resistant coatings by electrodeposition will grow at an accelerated pace both in volume and scope.

Disposal of toxic wastes from electroplating operations, particularly the cyanides and chromates, continues to be a major problem in the industry. Moreover, its magnitude is increasing with amazing rapidity. On the other hand, more effort has been devoted to this problem than at any other time in the history of electroplating. More than 400 individual research projects have been undertaken by public, industrial and private institutions and agencies.

Considerable progress has been made in this field, but the varied and highly complex problems leave much to be done. In addition to the problems which come almost entirely within the scope of the electroplating industry, metal finishers have concerned themselves with the disposal of pickle waste. Most plating shops must dispose of mixed wastes which makes satisfactory solution of the problem even more complex.

Recent design of waste treatment systems has been approached with several objectives in mind: (1) reduce the amount of waste, (2) recover waste and convert it to usable products and (3) conserve water. Any system incorporating these features will help to offset the high cost of waste disposal.

Many systems in commercial use are effective and efficient. Others, still in the research stage, show much promise. Practical research will concern itself primarily with better and less costly methods of control. As new methods of waste treatment are developed, federal, state and municipal governments may prohibit any plating plant from operating unless it is equipped to handle its waste safely.



Automobiles of the future will symbolize metal finishing progress. Since its beginning, the automobile industry has pioneered the development and practical application of more durable finishes, both organic and electro-deposited. Polyesters and epoxy resins, as well as the vinyl films, may make it possible to produce coatings consisting wholly of solids content. Another potential finishing material is one which will require no curing after spraying. Research in the field of water-base paints may establish a new trend in automotive finishing.

COMPLETE *Finishing* SYSTEMS

. . . for ENAMELS • LACQUER • PAINT • VARNISH



. . . the EXPERIENCE that goes into the PLANNING and ENGINEERING of MAHON EQUIPMENT is the item of GREATEST VALUE to YOU!

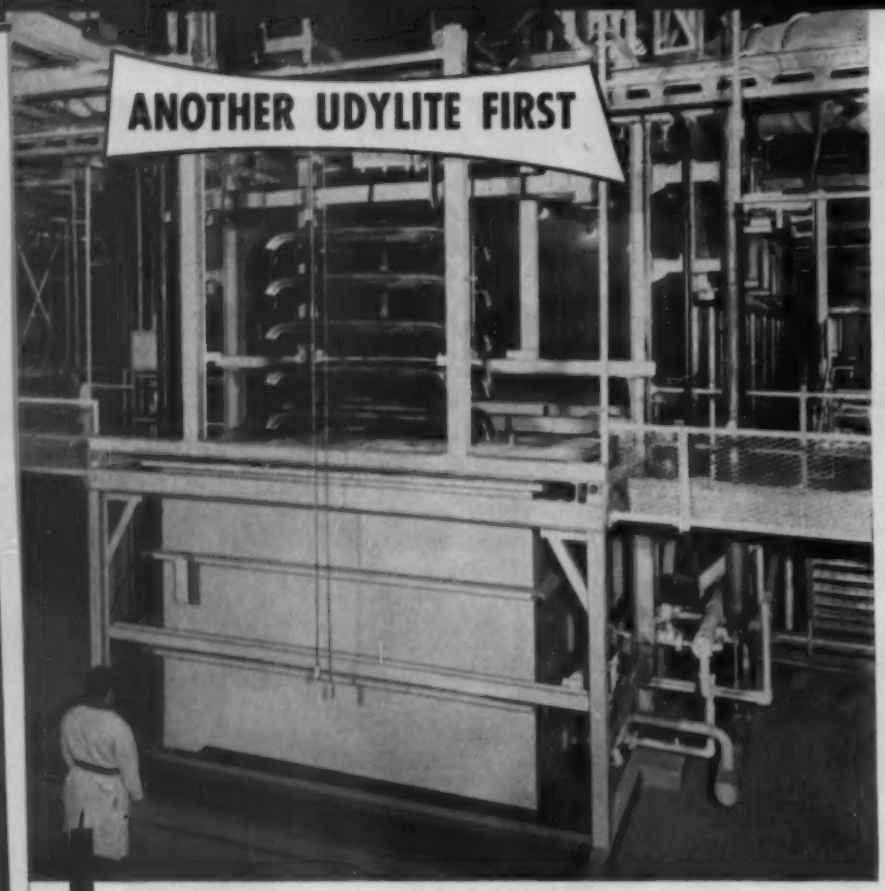
See Sweet's Plant Engineering File for information, or write for Catalog A-655.

. . . more Metal Products are Painted in Complete Mahon Finishing Systems than all other Types combined.

THE R. C. MAHON COMPANY • Detroit 34, Michigan

Engineers and Manufacturers of Complete Finishing Systems—including Metal Cleaning and Rust Proofing Equipment, Metal Cleaning and Pickling Equipment, Hydro-Filter Spray Booths, Dip and Flow Coaters, Filtered Air Supply Systems and Drying and Baking Ovens, Cooling Tunnels, Heat Treating and Quenching Equipment for Aluminum and Magnesium, and other Units of Special Production Equipment.

MAHON



480 FEET OF PLATING EFFICIENCY

Udylite Selective Cell Plating Machine Electroplates 360 Automobile Bumpers Per Hour

Today in one of the nation's largest automobile plants, bumpers are being copper, nickel, chrome plated with a quality of finish and efficiency of operation unmatched by any other method. This work is being done on a new automatic electro-plating machine—a product of Udylite research—which incorporates features exclusive in Udylite equipment.

The Udylite design allows for automatic selection of empty plating cells as the racks emerge from preceding operations. As they drop into the cells they fit around anodes in the tank that are hung to conform with the shape of the bumper. This assures quality plate on all curved surfaces. Efficiency in rack utilization is also a feature, for of the 84 racks used for the machine, only four are out of service during the normal plating cycle.

Udylite builds plating and metal finishing machines large and small. The Udylite Full Automatic was the first standardized plating machine ever offered to the industry. It brought economy, high production and process control at a low installation price.

If you have a plating problem it will pay you to consult Udylite. Write to:

THE Udylite CORPORATION
DETROIT 11, MICHIGAN

WORLD'S LARGEST PLATING SUPPLIER

Quotes: 1855 — 1955

Abstracts from past issues of THE IRON AGE, *selected for their flavor, and with some regard for whimsy:*

Galvanizing Iron

The discovery of galvanizing iron so as to render it less destructable, is one of great importance. It is based upon the fact that metals having an unequal affinity for oxygen, being brought into contact, produce an electrical current, which passes from that having the most affinity for oxygen to that having the least. Thus if zinc is applied to iron, the iron will never corrode as long as the zinc remains. Iron thus galvanized with zinc is applied to every possible purpose. It is corrugated for roofing and gutters, and affords the most durable and fire proof covering for all classes of buildings, at a cost of one-third that of slate.

August, 1859

Origin of Electroplating

The application of electrometallurgy to the arts was an accidental discovery. In 1830 Mr. J. P. Wagner of Frankfort and Prof. Jacobi of St. Petersburg were endeavoring to apply electromagnetism as a motive power instead of steam. Jacobi employed a Daniell's battery consisting of an outer cup of copper and an inner cell of unglazed porcelain which contains the zinc rod. The intermediate space is filled with a saturated solution of sulphate of copper. Once when Jacobi was busy with removing a deposit from his copper cup he noticed that there were several layers of copper, each having the form of the sides of the copper vessel and hence concluding that the sheet copper of which

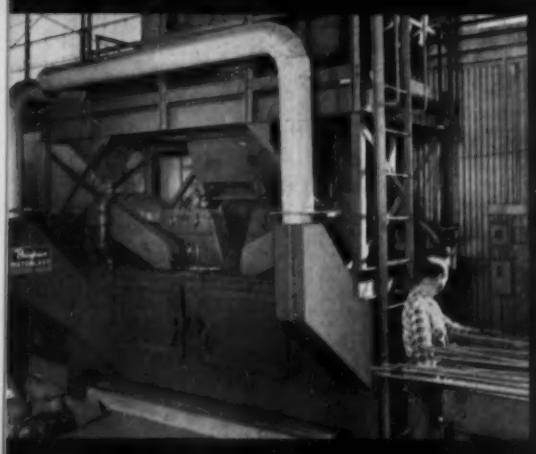
If you have







an unusual blast cleaning problem,



If you are a company with a special cleaning problem, Pangborn offers you a special service—a machine designed for your individual needs. It might be a descaling machine for bars, sheets and coils, a continuous-flow barrel or a monorail cabinet like the machines shown here . . . or it might be completely different. You may need to clean cylinder blocks, bathtubs or any unusual ferrous or nonferrous castings, forgings, stampings. If so, Pangborn engineers will study your problem and its relation to your production line. Then they'll design a Pangborn machine that gives you better cleaning and faster production at lower cost. Pangborn has proved it in hundreds of cases. Pangborn can prove it to you! Write today for Bulletin 1210 to: PANGBORN CORP., 1500 Pangborn Blvd., Hagerstown, Md. *Manufacturers of Blast Cleaning and Dust Control Equipment.*

*U. S. Pat. #2184926 (other patents pending)

Pangborn Rotoblast* can solve it!

Pangborn

BLAST CLEANS CHEAPER



Rotoblast Blastmaster® & Continuous-Flo Barrel



Rotoblast Tables & Table-Rooms



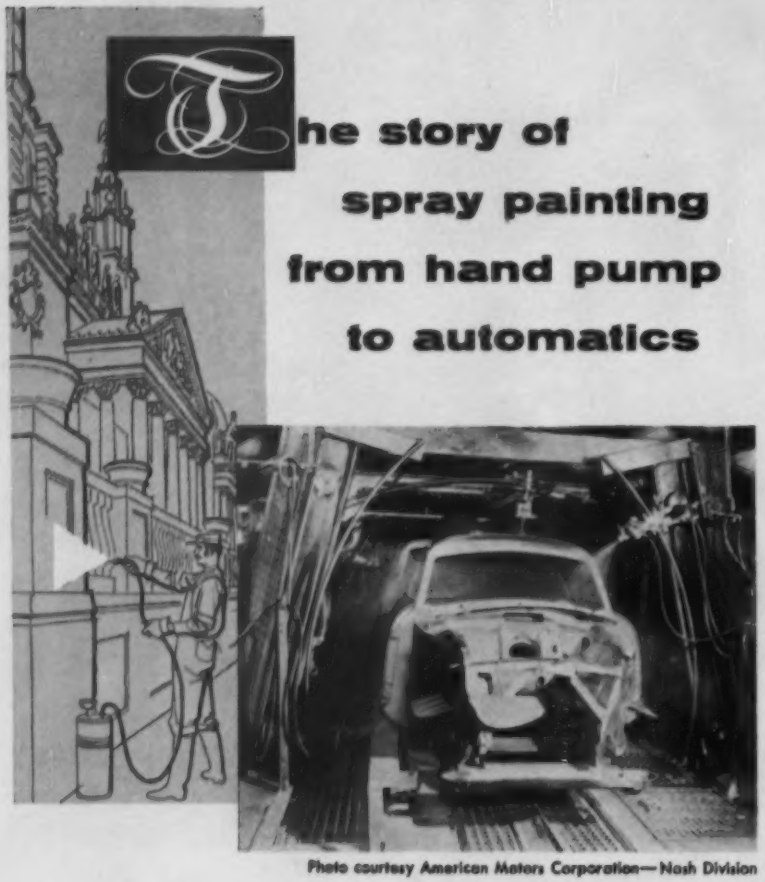
Special Blast Rooms & Cabinets



Pangborn Dust Control Equipment



Mallesbrasive* Shot & Grit



The story of spray painting from hand pump to automatics

Photo courtesy American Motors Corporation—Nash Division

In 1893, about three weeks before the Columbian Exposition was to open, horrified officials learned some of the buildings would still be unpainted. There just weren't enough hand painters available to do the job. That's when Joseph Binks introduced his "spraying machine," which did the work of 30 men. Painters, equipped with these primitive spray painting units, finished the job on time.

About 35 years ago, a group of automobile manufacturers met in a Detroit hotel. They were faced with the problem of how to apply the recently developed quick-drying lacquers. Existing methods were not applicable. Before this group, Joseph Binks demonstrated his revolutionary internal atomizing spray gun and the problem of applying lacquers and other finishes was solved.

Today, new finishing problems confront industry...and new equipment and techniques provide the answers. Binks spray guns are applying plastic coatings, porcelain enamels, heavy sound deadeners and undercoatings, lubricants, adhesives...anything that will flow. Binks automatic equipment is keeping finishing operations *abreast* of automation.

Binks engineers will be glad to work with you in selecting the right equipment and layout for your shop...or in developing new equipment to meet your requirements.

Binks
EVERYTHING FOR SPRAY PAINTING


GUNS


SPRAY BOOTHS


FREE INSTRUCTION

BINKS MANUFACTURING COMPANY
3124-30 Carroll Ave. West, Chicago 12, Ill.

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the vessel was made had split up into layers, accused the man who made it of employing a poor quality of copper. A closer investigation, however, showed him that these layers or leaves did not belong to the walls of the vessel, but to a new deposit of metal imitated in a remarkably perfect manner, the shape of the surface of the wall. It occurred to Jacobi that this troublesome disadvantage could be turned to profit by using it for producing objects.

Apr. 23, 1874

Color on Zinc

A difficulty is often experienced in causing oil colors to adhere to sheet zinc. Boettger recommends the employment of a mordant, so to speak, of the following composition: one part of chloride of copper, one nitrate of copper and one of sal-ammoniac are to be dissolved in sixty-four parts of water; to which solution is to be added one part of commercial hydrochloric acid. The sheets of zinc are to be brushed over with this liquid, which gives them a deep black color; in the course of from twelve to twenty-four hours they become dry, and to their now dirty gray surface a coat of any oil color will firmly adhere. Some sheets of zinc prepared in this way, and afterward painted, have been found to entirely withstand all the atmospheric changes of winter and summer.

Jan. 5, 1873



Bettmann Archive

CAST IRON enameling once involved much manual effort. The workers are wearing masks.

you cut costs—
improve your products
with
pre-coated
Thomas Strip



Costs go down—product quality goes up, when you use Thomas *pre-coated* strip in stamping and drawing light-metal parts. Savings show up in almost every direction.

It has a clean, smooth-surface finish which eliminates the cost of preparation before fabrication. In many instances, all that is necessary is to fabricate and assemble, as cleaning, plating, and buffing operations are not necessary. Often the tightly adhering, non-ferrous coating serves as the final finish. The coating also acts as a die lubricant, increases die life, reduces wear and cuts re-tooling costs. It protects the base metal during manufacturing processes.

In addition to these many cost saving advantages, *pre-coated* Thomas Strip improves products by providing a uniform finish on products inside and out. It adds substantially to product life and appearance, at low cost.

To lower operating costs and increase product acceptance use *pre-coated* Thomas Strip. For assistance in selecting the most desirable coating for your products from the wide variety listed below, write today.

Cold-rolled strip steel electrolytically coated with zinc, copper, brass, lead-alloy, nickel or chrome in natural, planished and buffed finished, also with rolled-in Pattern Design—uncoated low carbon alloy and high carbon spring steels. Carefully produced to your specifications.

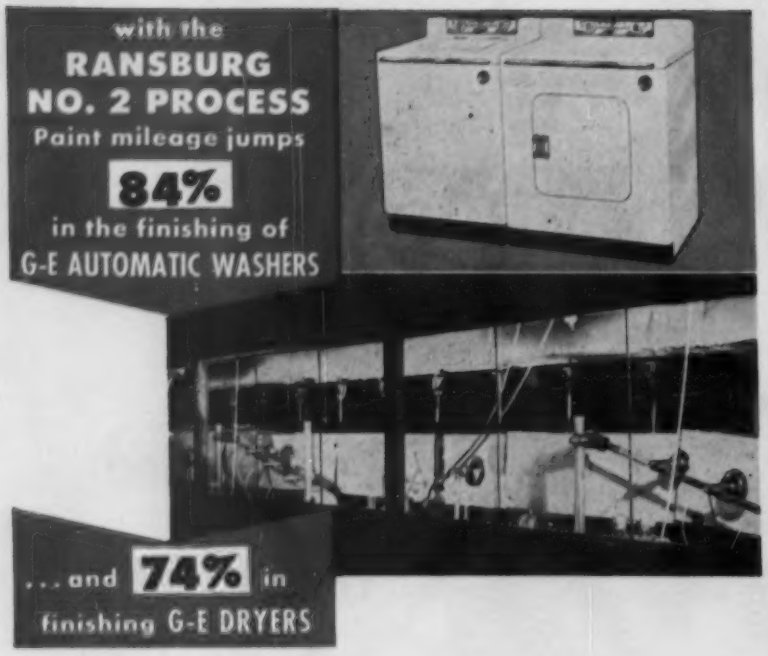
Write for new full color sample booklet.

Thomas Strip

a product of

Thomas Strip Division

Pittsburgh Steel Company • Warren, Ohio



Production is increased and quality of the work is improved over former hand spray method

● When General Electric formerly hand sprayed their home laundry equipment—automatic washers and dryers—they painted 9.74 washers with a gallon of paint. Now, in the new and modern plant at Appliance Park, Louisville—where they're using the Ransburg No. 2 Process—they get 17.97 units per gallon of paint. An increase of 84%!

And, where they formerly got 5.49 dryers per mixed gallon of finish, now—with the Ransburg No. 2 Electrostatic Spray Process—they get 9.56 dryers per gallon of paint. An increase of 74%!

Along with increased production, G.E. is getting a more uniform, higher quality finish. Another typical, on-the-job-example of the unmatched efficiencies of the Ransburg No. 2 Process of electrostatic spray painting!

Want to know what Ransburg Electrostatic Processes can do for you in your finishing department? Ask about the complete facilities for test-painting YOUR products—under simulated production conditions—in Ransburg laboratories.

Write to Dept. IA

Ransburg ELECTRO-COATING CORP.
Indianapolis 7, Indiana

Tinting Iron, Steel

Dissolve, in four parts of water, two parts of crystallized chloride of iron, two parts of chloride of antimony and one part of gallic acid, and apply the solution with a sponge or cloth to the article and dry it in the air. Repeat this any number of times, according to the depth of color which it is desired to produce. Wash with water and dry, and, finally, rub the articles over with boiled linseed oil. The metal thus receives a brown tint and resists moisture.

May 6, 1880



Bettmann Archive

POLISHING room, about 1855. Wheels were of wood covered with emery.

Pearl Inlay on Iron

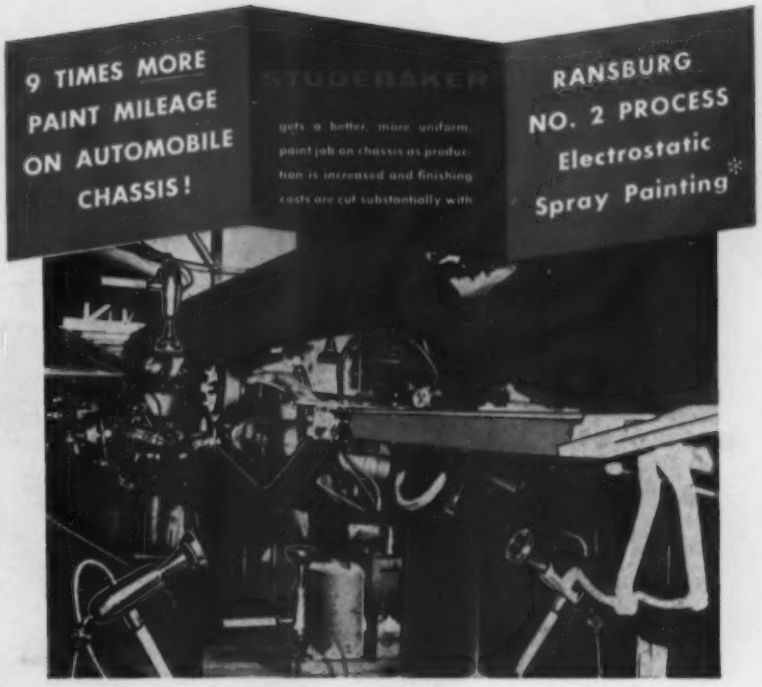
The method by which pearl inlays are made upon enameled or japanned cast or sheet iron is very simple, and at the same time the results obtained are very striking.

Cast and sheet iron and *papier mache* are the materials upon which pearl is generally inlaid. If the article be of cast iron, it is well cleaned from the sand which usually adheres to the casting, and is blackened with a coat of varnish and lampblack. When this is thoroughly dried, a coat of japan or black varnish is spread evenly upon it. Before the varnish becomes too dry, pieces of pearl

cut in the form of leaves, roses or such flowers as the fancy of the artist may dictate, or the character of the article may require, are laid upon the varnish and pressed down with the finger, and they immediately adhere to the varnished surface. The sheets of pearl may be obtained so thin as to be more like paper than anything else. After the pieces are in place the work is put into a heated oven and kept there for several hours, or until the varnish is perfectly dried. It is then taken from the oven and another coat of varnish applied indiscriminately on the surface of the pearl and the previous coating, and again placed in the oven till dry. This process is repeated several times, until the thickness of the varnish is such that top of the pearl is level with the body of the varnish, which is then scraped off the pearl with a knife, and the surface of the pearl and varnish around it are found to be quite even. The pearl is then rubbed with a piece of pumice-stone and water, and the surface of the varnish is rubbed smooth with powdered pumice - stone, moistened with water.

Adheres With Firmness

It is in this unfinished state that the pearl has the appearance of being inlaid, and from which it derives its name. It is, in fact, inlaid in the varnished surface, to which it adheres with surprising firmness. Its final beauty and finish depend altogether on the skill of the artist under whose hands the shapeless and almost unmeaning pieces of pearl are made to assume the form of beautiful flowers, leaves, &c. The artist traces the stems and leaves of the flowers with a camel's hair pencil dipped in a size made of varnish and turpentine; upon this he lays gold leaf, which adheres where there is size, and the superfluous gold is carefully brushed off with a piece of silk. The flowers and leaves are then painted in colors, and when dry the picture and surface of the article are covered with a coat of refined white varnish. One point



● When Studebaker Division, Studebaker-Packard Corporation switched to Ransburg No. 2 Process of Electrostatic Spray painting on their automobile chassis, paint mileage was increased 9 times.

By simply putting the paint where it's supposed to go, Studebaker cut daily paint consumption on the chassis production line from 14½ drums to 1½ drums. And, still they are painting 6 more chassis per hour with the No. 2 Process.

In addition to getting better, more uniform coverage with the asphalt-type coating, paint and labor costs were cut 70¢ per chassis. In eliminating the former set-up with 2 water wash booths and 12 automatic spray guns, they save nearly 1000 square feet of badly needed floor space.

Another on-the-job-example of the unmatched efficiency of the Ransburg No. 2 Process in which quality of the work is improved . . . AT LESS COST!

* *Studebaker also uses the Ransburg method to apply a heavier and more uniform primer surfacer on automobile bodies.*

Whatever your product—large or small—if your production justifies conveyorized painting, it's possible that one of the Ransburg electrostatic processes can do the job better, with substantial savings to you. We'll be glad to tell you about complete Ransburg services.

Write to Dept. IA

Ransburg ELECTRO-COATING CORP.
Indianapolis 7, Indiana

Complete from Cleaning through Baking . . .

1000 PARTS PER HOUR in Space 16′ x 40′

ENGINEERED BY . . .

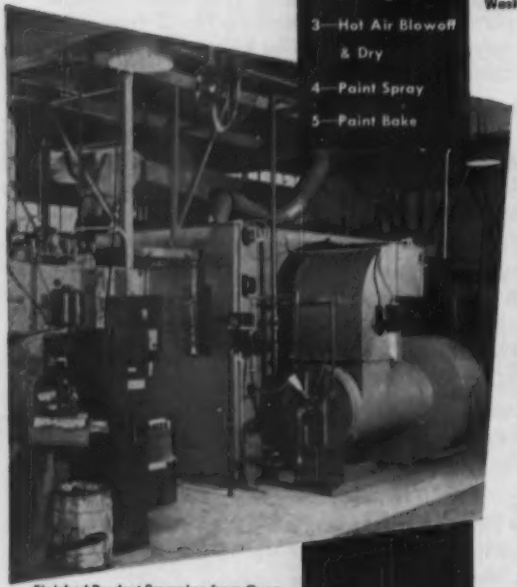
Cincinnati
CLEANING AND FINISHING MACHINERY CO.

at The
George R. Carter Co.
Detroit, Mich.



Washing, Rinsing and Hot Air Blowoff

OPERATIONS:
1—Washing
2—Rinsing
3—Hot Air Blowoff & Dry
4—Paint Spray
5—Paint Bake



Finished Product Emerging from Oven

Unusually compact, this CINCINNATI-engineered small parts finishing system has proved to be a major improvement in The George R. Carter Company's production facilities. Complete finishing operations on automobile trim hardware parts are performed efficiently and quickly.

With a minimum of adaptation this Cincinnati system can handle a large variety of small parts. Representative installations have shown savings up to 75% in time and cost.

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2017 Hageman St., Sharonville, Ohio

should be observed, which is too frequently forgotten by those who paint upon pearl in this country, and that is to use only transparent colors when painting on the pearl itself. This is the secret of the great brilliancy obtained in most of the European work upon pearl.

Feb. 12, 1880

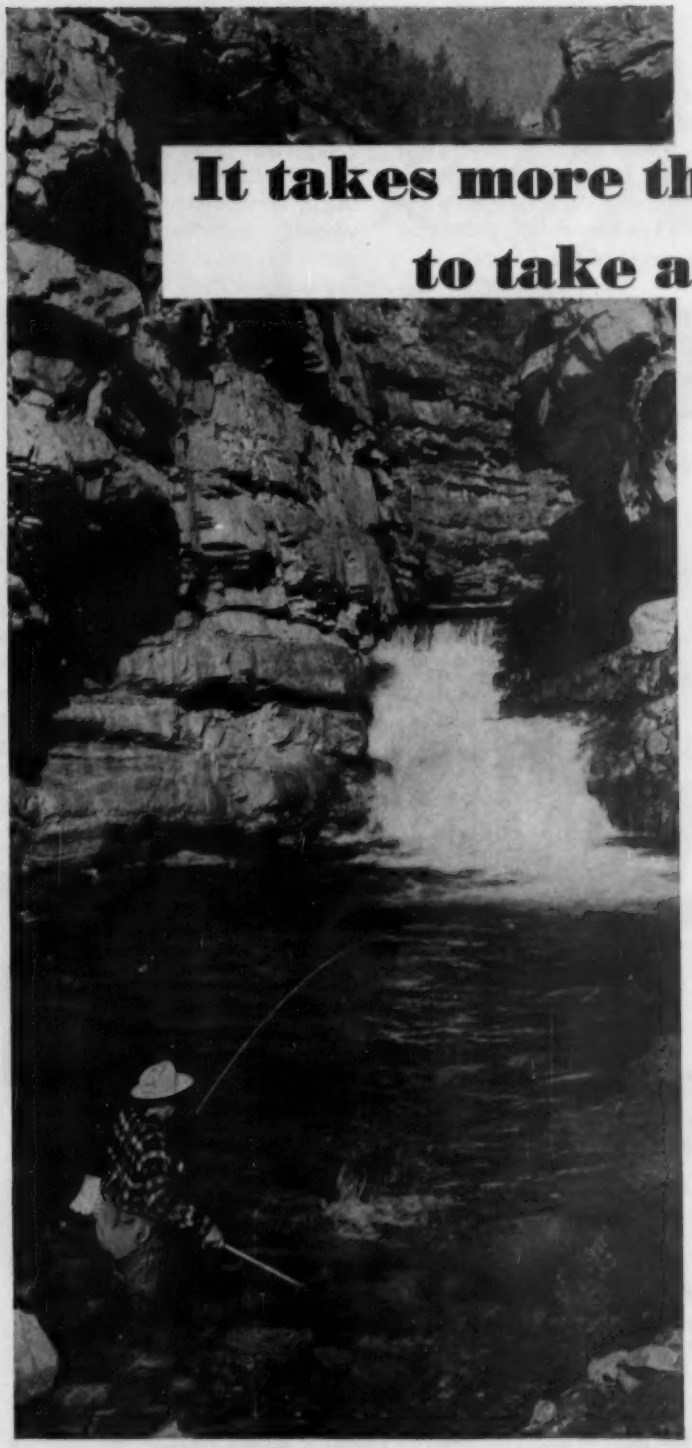


Bettmann Archive

MECHANICAL process of enameling cast iron as used about 1900.

Gas Industry Grows

Within a single year great strides have been taken at Pittsburgh in the natural gas industry, says a correspondent. In the city alone not less than $6,000,000 are invested in practically applying the gas. Add to that its introduction as fuel in surrounding towns and the villages of adjoining counties, and it will make an additional $4,000,000, or a grand total of $10,000,000 invested in an industry in Western Pennsylvania that was practically unknown a few years ago. This sum embraces the cost of boring wells, labor and machinery requisite for the work, purchase of the land on which wells are located, purchase of right of way for pipe lines, increase in machinery of pipe mills for the manufacture of thousands of tons of



It takes more than a good fly to take a trout

Even the costliest fishing gear, the finest rod, the best reel and the prettiest fly can't assure catching a wily trout. It's the experience behind these accessories, that fills the creel.

There's no substitute for "Know-How" and that's particularly true in adapting metal treating chemicals to established production. It can't be gotten out of books, through black magic or out of a crystal ball. Only years of active contact, with actual manufacturing procedures, can be depended upon for satisfactory solutions of the metal protecting problems constantly confronting manufacturers.

ACP offers ideal products for removing and preventing rust on metal, chemicals to bond paint to steel, zinc, and aluminum, and pickling acid inhibitors. In addition, ACP furnishes a free service of an organization of technical experts with over 40 years' experience in solving metal preservation problems for the largest as well as the smallest operation.

Rely on service backed by experience. You are obligated in no way by consulting our technical staff.

Write or call for further information on ACP chemicals for metal protection.

Since 1914, Pioneering Research and Development in Metal Protection

CHEMICALS ACP PROCESSES

AMERICAN CHEMICAL PAINT COMPANY

CHEMICALS ACP PROCESSES

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DETROIT, MICH. **NILES, CALIF.** **WINDSOR, ONT.**

pipes, the cost of these iron pipes, freight bills on the delivery of pipes, the wages of thousands of laborers in laying pipe lines, plumbing and pipe-fitting in mills, factories and dwellings, changes necessary for the adaptation of furnaces and stoves for the use of natural gas, and the manufacture of gas fittings, gauges and meters. A year ago the subject was insignificant. To-day it ranks in importance with the iron, steel, glass and coal interests of Western Pennsylvania. Each and every one of them has become dependent on the resources of the new fuel.

Jan. 1, 1885

OUR REPRESENTATIVE FIELD ENGINEERS ARE AT YOUR SERVICE TO HELP REDUCE FINISHING TIME, LABOR AND COSTS WITH MODERN —

RANSOMATION

COMPLETE SYSTEM
AUTOMATION
IN ANY COMBINATION OF TREATMENTS FOR CLEANING AND FINISHING METAL PARTS.

RANSOHOFF, INC.
670 NORTH FIFTH STREET
HAMILTON, OHIO

Wood Carver's Wail

Between the high rents and competing iron manufacturers, New York wood-carvers are having a serious time. One of them recently remarked: "Before rents got so high that all the ship building and repairing was driven down East, around Portsmouth and Maine, there was a good deal of ship-carving — figure-heads and the like, which pay better than cigar-store figures—to be done about here. Now it's all gone, and we have to fall back on wooden Indians. Sometimes we get a wooden coat of arms to make for some rich man. They pay pretty well. Wooden figures don't pay so well. This Indian chief will cost the owner $50; that Sultana, $45; the little Indian squaw to the right of you, $25, and so on. They have begun to make cast-iron figures at some of the iron works, and that cuts in on us, of course."

Jan. 1, 1885



Bettmann Archive

IN 1888 castings were cleaned by dry tumbling in barrels.

Slag for Ballast

In order to adopt it to such purposes as ballasting for railways, road metal, &c., the blast furnace slag at the George-Marie furnaces at Osnabruck, in Hanover, is allowed to flow from a height of eight feet into water, the effect of which is to convert it into large bean-shaped gravel; as fast as this is formed, it is lifted out of the water by an endless chain of buckets, which load it directly on the railway trucks.

Feb. 13, 1873



Rotary Embossing a Bright Idea

For Strip or Sheet Metals

MEMCO

MASTER Hydraulic Embossing Machines

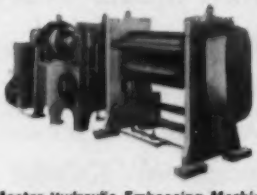
and Engraved Matched Hardened Forged Steel Embossing Rolls

Rotary embossing with MEMCO Hydraulic Machines and *matched* flame hardened steel rolls gives your product a *deluxe appearance*—at a cost figured in fractions! Whether you use "localized" embossing or all-over patterns, this bright idea for metals adds the *product punch* that sells. Or it may prove to be an important *cost-saver* . . . in materials . . . in man-hours. Designs can be simpler, construction cheaper, when you use embossed metal for decorative styling, trim, nameplate or other "finishing touch."

And MEMCO's *modern*, high *speed*, high *precision* methods and equipment—using exclusive flame hardened rolls for maximum life—end down time and bottlenecks, accelerate your production. Use rotary embossing on your present products . . . *design it in* on future models. Consult MEMCO for *all* the facts on this bright idea in metal!



MEMCO



Master Hydraulic Embossing Machine

High speeds—50 to 500 feet per minute! Precision finger-tip control for easy operation. Embosses in sheet, coil or strip on all metals. Available in 5, 10, 20, 50, 100 and 175 ton models.



Flame Hardened Embossing Rolls

Precision matched rolls of forged steel to emboss the most complex patterns and textures on one or both sides of any metal. Flame hardening insures utmost durability.

Modern Engraving & Machine Co.
1413 Chestnut Avenue, Hillside 5, New Jersey

Send for Complete Information

MEMCO
Modern Engraving & Machine Co.
1413 Chestnut Ave., Hillside 5, N. J.

Gentlemen: Please send me all available literature and complete details on rotary embossing with MEMCO equipment.

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COMPANY.....

ADDRESS.....

CITY.....ZONE.....STATE.....

yesterday · today · tomorrow

LOWE Brothers

the name for LEADERSHIP in industrial finishes

today it's VINOC • Lowe Brothers latest development — a finishing system for high speed production

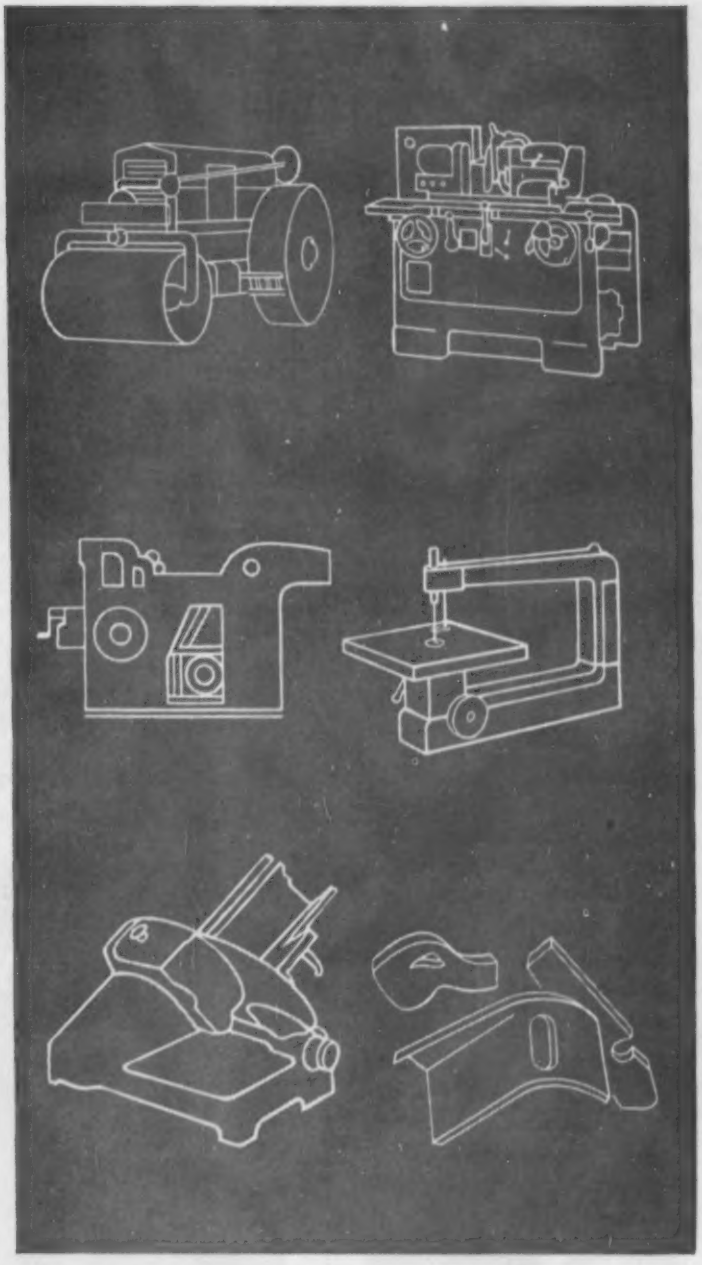
Faster flow of finished castings, reduced handling costs, finishes that resist modern high-speed coolants—*these* are the demands of today's production. Lowe Brothers "Finishing Specialists" have once more demonstrated their leadership by developing **VINOC,** a finishing system which meets every modern requirement, yet maintains the highest standards of beauty and wearability which made the Lowe Brothers name great!



EXTRA—The new filler in the VINOC system glazes with unprecedented ease, speed and smoothness with knife or squeegee!



ENGINEERED QUALITY



IMPROVED RESISTANCE TO MODERN HIGH-SPEED COOLANTS! Lowe Brothers **VINOC** finishes have proved impervious to all modern coolants to which they have been subjected—to keep in stride with today's requirements of streamlined production techniques!

FASTER, ECONOMICAL CLOG-FREE SANDING! Pigmentation of Lowe Brothers new *filler* is such that it does not clog sandpaper! It sands *easier*—desired smoothness is realized in less time with much less work! What's more, you enjoy a marked savings on *sandpaper alone!*

FASTER DRYING! Lowe Brothers **VINOC** system reduces drying time to a new low—speeds handling. Materials dry free of "pinholing"—as a result there's no re-working necessary!

IMPROVED RESISTANCE TO IMPACT AND COMPRESSION! Large castings take plenty of shocks and scuffs during plant handling operations. Lowe Brothers **VINOC** finishes are made tougher to resist this rough treatment and thereby reduce need for patch work.

Lowe Brothers new **VINOC** finishing system is available for either cold or hot lacquer application. Get full details now—see how *you* can save time and cost while getting finest finishing results with Lowe Brothers' up-to-the-minute answer to the most modern production needs—**VINOC!** Write today for prompt service without obligation.

LOWE Brothers

FINISHES FOR INDUSTRY SINCE 1870



The Lowe Brothers Company • Dayton 2, Ohio
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Stays on Where other Paints Burn Off

Painting of hot surfaces poses a difficult problem both for the equipment manufacturer and the maintenance superintendent.

The solution is found in HEAT-REM H-170. This extra-high heat resistant, silicone base aluminum paint will withstand temperatures up to 1700°F. Unlike ordinary high heat paints, H-170 can be successfully applied at normal temperatures and will air dry.

HEAT-REM fuses with surface metal, protects with a bright aluminum finish and will not burn off. It is suitable for brush or spray use, indoors or out... resists fumes, moisture, acids.



Write today for full details and list of users

*HEAT-REM H-170 is widely used on stacks, boilers, steam lines, mufflers, radiators, exhaust manifolds, piping, ovens, compressors, condensers . . . everywhere that heat is present.

SPECO INC.
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Jan. 22, 1885

ACKNOWLEDGMENT

In addition to those mentioned in the text or in photo credits, the editors also want to thank the following for their help in preparing this section:

George Dubpernell, United Chromium Corp.; F. A. Lowenheim, Metal & Thermit Corp.; American Chemical Paint Co.; E. I. Du Pont de Nemours & Co., Inc.; E. F. Houghton & Co.; Oakite Products, Inc.; Pennsylvania Salt Mfg. Co.; Submerged Combustion Co. of America; The Udylite Corp.; Wyandotte Chemicals Corp.

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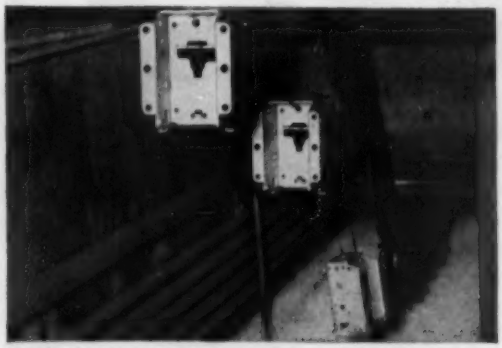
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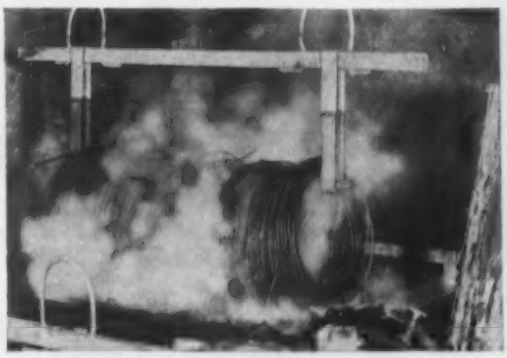
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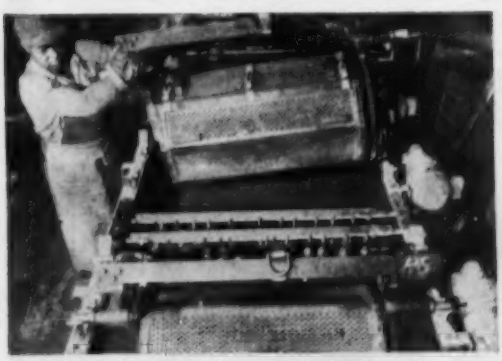
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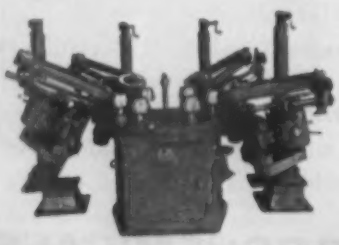
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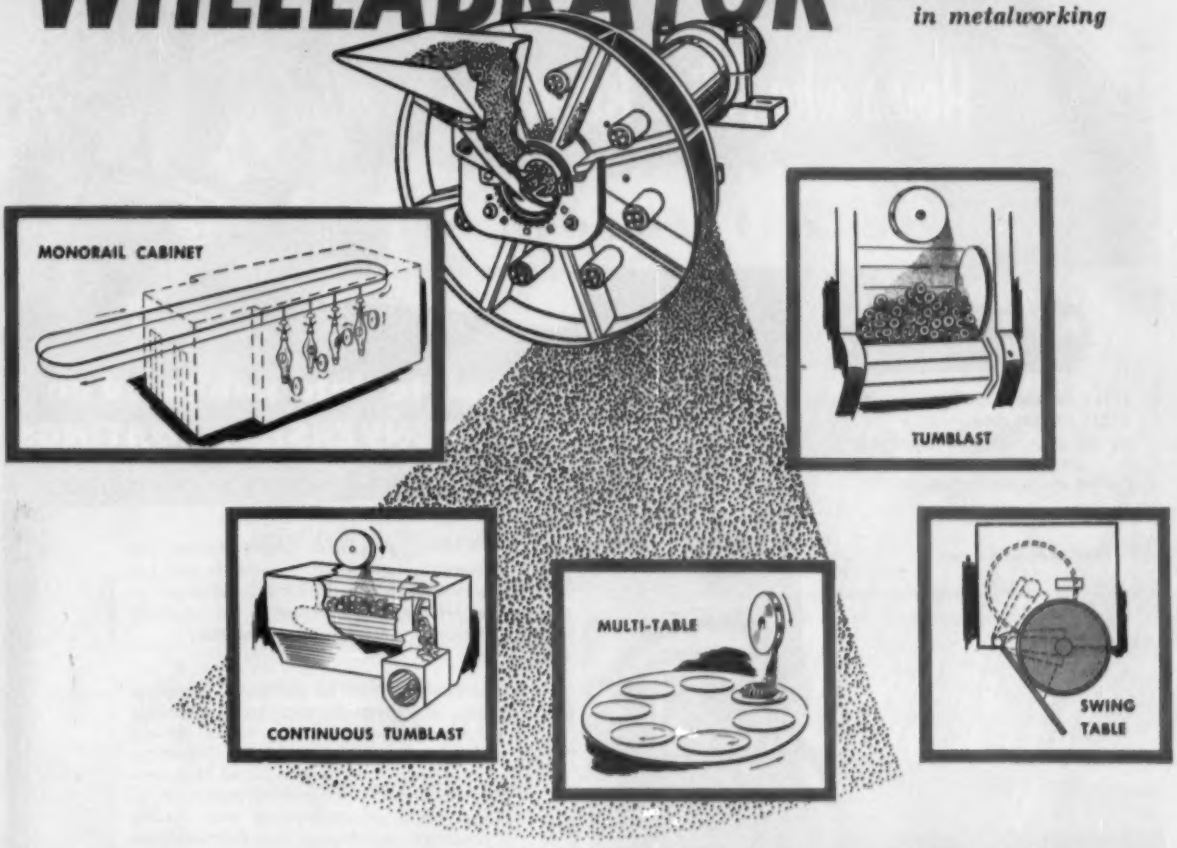
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nonferrous metals

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NONFERROUS METALS 1855 1955

NONFERROUS METALS fall historically into two major groups—the ancient and the modern. Some—gold, copper and bronze—were well known thousands of years ago. Yet many of the common modern metals were not seen by man until the late 18th or early 19th centuries.

Nickel, molybdenum, titanium and zirconium were discovered in the latter half of the 18th century; lithium, aluminum, magnesium, vanadium and many others were first isolated in the period up to 1830.

◆ ALUMINUM is today's top nonferrous metal in tonnage. It has only just achieved that status. The price for 99 pct pure pig is about 21.5¢ per lb. Yet in 1852 it was $542 per lb. By 1860 the price had plummeted to $17 per lb with Sainte-Clair Deville's process and it gradually came down to about $8 per lb by 1886.

This was the year that saw aluminum really born as a commercial metal. This was the year when a young American by the name of Hall and a young Frenchman by the name of Heroult each arrived, independently, at the process still used to smelt aluminum.

Their discovery was that metallic aluminum could be produced by dissolving alumina (aluminum oxide) in molten cryolite (sodium aluminum fluoride) and passing an electric current through the solution.

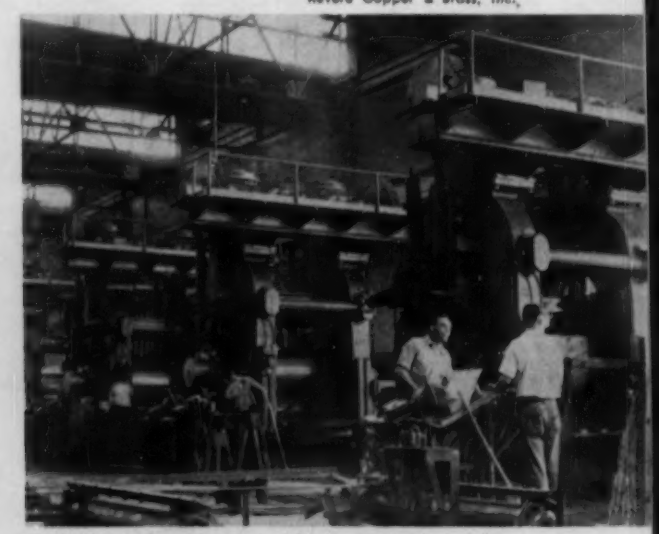
First commercial production of aluminum by the newly formed Pittsburgh Reduction Co. (since renamed Aluminum Co. of America) was in 1888. The company offered aluminum in 1000-lb lots at $2 per lb, but nobody wanted any until the firm went ahead and made some tea kettles. A well-known utensil firm added aluminum to its line and the new metal was off to a start.

Aluminum Co. of America



ALUMINUM ornamental casting placed atop the Washington Monument in 1884 is still in place.

Revere Copper & Brass, Inc.



COPPER industry's first 4-high, 4-stand tandem mill started rolling in 1928 at Rome, N. Y.

Within 5 years of Hall's discovery the price was down to 65¢ per lb. By 1900 it was 32¢.

A few years after aluminum was first used in battle—as canteens carried by troops in the Spanish-American War—came an event that really threw aluminum's light weight to the forefront. That was the first flight of a powered airplane on Dec. 17, 1903; the 16-hp engine used by the Wrights had a 152-lb aluminum crankcase.

In the same year, Alfred Wilm, a German, discovered the ability of certain aluminum alloys to age harden. He worked with an alloy containing approximately 4.0 pct copper, 0.5 pct manganese and 0.5 pct magnesium, with a small percentage of silicon as an impurity. This he marketed as duralumin. It led to the present 2024 (24S) and 7075 (75S)—today's major aircraft alloys.

Following World War I there was steady development both in markets and technology of the light metal. Peak annual production during World War I was in 1917 when 64,939 tons of primary metal were produced. Output dipped in 1918, then rose to 69,021 tons in 1920. This toppled in '21 and '22, then began a more or less steady rise to 114,518 tons in 1930. A low of 37,088 was hit in 1934.

Aluminum starts biggest growth

Production then began an upswing to 163,545 tons in '39; 309,067 tons in '41; and a World War II peak of 920,179 tons in '43.

Other major events of the war years: Reynolds Metals Co. became a producer in 1941 and Kaiser Aluminum & Chemical Corp. in 1946.

Production fluctuated after the war, hitting a low of 409,630 tons in 1946 and then climbing more or less steadily on aluminum's civilian applications to 718,622 tons in 1950, the year that saw the Communists cross the 38th Parallel into South Korea.

This started the biggest growth yet seen in aluminum and again this industry added more facilities—percentagewise—than any metal industry. Capacity was doubled in a 4-year period, establishing aluminum as the No. 1 nonferrous metal. New all time production records were set in 1952 (937,330 tons), in 1953 (1,252,015 tons), and in 1954 (1,460,587 tons). This year will probably see the fourth consecutive annual production record at about 1.5 million tons.

◆ COPPER is one of the oldest known metals, probably antedated only by free gold and possibly by meteoric iron. Alloying with tin is also so old that its discovery date is lost in antiquity. But its intentional addition to zinc to form brass is relatively recent, only a few hundred years old. Copper's outstanding property—high electrical conductivity—was not put to use until modern times.

By the time THE IRON AGE came onto the scene in 1855, copper and brass fabricating was already firmly rooted in Connecticut's Naugatuck Valley. It's still in New England to the tune of 42 pct of the nation's brass mill output.

Copper mining in the United States got its real start in 1845 with the first production from the Cliff Mine in the Upper Michigan Peninsula. Existence of native metallic copper in the area had been known for nearly 200 years. By 1860, production from the Lake Superior area was over 5000 tons annually with total United States output at about 8000 tons.

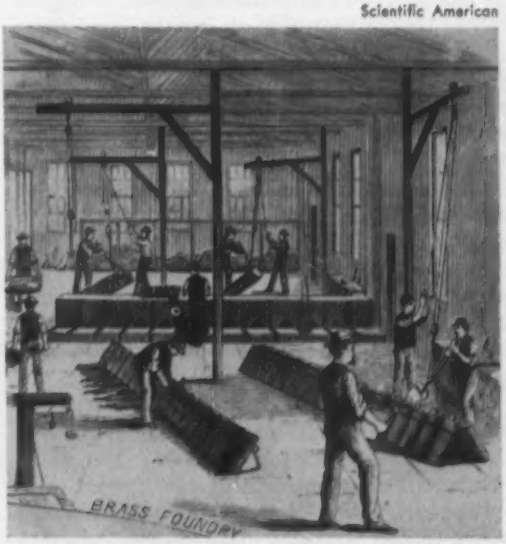
Montana takes copper lead

The Lake mines continued to dominate until 1880 (Lake production, 24,868 tons; total United States, 30,240 tons) when copper mining began in Arizona and Montana. In 1887 production in Montana surpassed Lake Superior output and Lake copper, while growing, never regained its lost dominance. Total United States output that year was about 93,000 tons with Montana and Lake Superior each contributing about 38,000 tons.

Actually, early copper production was simpler than today's because of the nature of the deposits. The Lake copper was free metal that required only mechanical separation from the rock—though in some instances the chunks of metal were so large that they had be cut down to be removed (masses weighing from 1 to 25 tons were not rare).

Near the end of the nineteenth century the copper industry came to rely more heavily on the sulphide ores which could be fused into matte. Froth flotation for concentrating sulphide ores was introduced into the United States at the beginning of the present century.

Scientific American



BRASS foundry of the mid-1880's era employed simple hoists to aid pouring operations.

Up until about 1910 matte smelting was done in small, rectangular blast furnaces, but since ores were still getting leaner, the blast furnaces became less practicable. This was because too much of the fines would blow out the stack, and the leaner ores required finer crushing and grinding for concentration.

The reverberatory furnace proved the answer. Here the ore-flux mixture is banked along the sides of the long furnace and flames are played over it from one end. Blister copper is produced in side-blown converters which oxidize the sulphur.

Electrolytic refining, the current method of purifying blister copper, was introduced into the United States about 75 years ago.

In 1900 United States production passed the 300,000-ton mark (smelter production); in 1904 the 400,000-ton mark went down and 500,000 tons was reached in 1909. The high during the first World War was 964,925 tons in 1916. A bad slump followed which brought United States output down to a low of 252,793 tons in 1921.

The industry rebounded to pass the million-ton milestone in 1929. Depression cut that figure in half, then in half again to a 1933 low of 225,000 tons. A million-ton annual production was not again achieved until World War II and the figure was topped in '42, '43 and '44. Again output dipped after the war. And again war, this time Korea, brought annual production to over 900,000 tons in 1950 and there it stayed until last year's strike knocked it down again.

Magnesium from sea water

◆ MAGNESIUM, first isolated about 1828, was produced by electrolysis as early as 1833 and the first commercial production took place in Germany in 1886 using an electrolytic cell based on one developed by Bunsen in 1852.

The United States didn't get into production until 1915 when the World War I blockade of Germany cut off the only supply. Six firms followed the initial production by General Electric Co. but by 1920 all had quit but American Magnesium Corp. and Dow Chemical Co. The former ceased production in 1927 and the Dow plant at Midland, Mich., was alone in the field until World War II.

By mid-1943 there were 11 producers of which 9 were operating government plants. Since the end of the war, except for a period during the Korean conflict, Dow has again been in the position of an unwilling monopoly.

The most significant date in the commercial history of magnesium was November 1941 when Dow initiated production from sea water at its Freeport, Tex., plant.

Peak production of magnesium was reached in the United States in 1943, 183,584 tons. But output slumped to only 5317 tons in 1946.

As the industry concentrated on civilian applications, this low figure was approximately doubled in the 3 years following. The Korean conflict then boomed magnesium again to a high of 105,821 tons in 1952. But again the metal slumped after the peak.



Continuous Metalcast Co.

CONTINUOUS CASTING brass on Junghans unit began in U. S. in 1938 at Scovill Mfg. Co.

◆ NICKEL, originally named for the Devil, has today taken over as the No. 1 high-temperature metal of the jet age. It got its name in the first half of the 18th century when miners in Saxony recovered an "unworkable" metal from what they thought was copper ore. They called it Kupfer-Nickel (Old Nick's copper) in the belief that the Devil had cast a spell over it.

Knowledge and use of nickel grew slowly during the century following discovery in 1751 with deposits developed in Norway about 1840 and in New Caledonia about 1877. World output was under 1000 tons a year when copper mining began in Sudbury, Ont., in 1886.

Properties of nickel steel were reported in 1889 and the United States Navy became interested. The search for an economic way to supply nickel led to development of the Orford process for separating nickel from copper. This process was used for some 60 years, being replaced in 1947 by matte flotation.

Also in 1889 the British Mond process was developed. While quite different from the Orford method, the results were pretty much the same and the process is still used.

World War I contributed much to nickel technology and use, particularly in tougher nickel steels. But after the war the markets faded and new outlets were vital. One of the directions taken to accomplish this was establishment in 1921 of a rolling mill at Huntington, W. Va., for the production of nickel and Monel, which had been sold since 1905.



Dow Chemical Co.

MAGNESIUM from sea water was a major step. Watching first pour (1941) is W. H. Dow.



Du Pont

TITANIUM crystals on electrode unit represented peak output in early titanium research.

In World War II the armed forces came to depend so heavily on nickel alloys that extensive research was required to conserve nickel supplies. The NE or National Emergency steels resulted.

◆ LEAD, another ancient metal, provided the proving ground for many of today's metalworking techniques. Ease of smelting the ore and the metal's extreme malleability and low melting point made it easy.

The Romans, for instance, joined their lead pipe plumbing by a technique which could loosely be called welding. They poured molten metal around the joints. Another example from the middle of the 19th Century: Extrusion.

The most significant developments in lead during the past 100 years have been in its uses. The automobile brought lead's two most important markets—batteries and tetra-ethyl lead—while large scale use of electricity added cable covering as a third huge market. Plumbing is another where its position has hardly been challenged.

◆ ZINC is another metal that came to man in ancient days. Two of its top uses were already known when THE IRON AGE was first published 100 years ago. As an alloying element for copper to form brass, it was already well known. And the galvanizing process in which a zinc coating protects steel had been invented in 1837. The third major use, chronologically, is diecasting.

Probably the three outstanding events of the past century in zinc were: (1) Initial mining of zinc in the Tri-State area (Missouri, Kansas and Oklahoma) about 1870; (2) development of the flotation process which paved the way for later utilization of the complex Rocky Mountain ores; and (3) advent of electrolytic refining in Montana during World War I.

◆ CONTINUOUS CASTING—on a commercial scale—is relatively new, though Sir Henry Bessemer produced some continuously cast sheet iron in 1856. In the first report ever published anywhere on the subject (THE IRON AGE, March 21, 1935) it was noted that lead and brass were being directly rolled into strip from molten metal. It described the process on a Hazlett mill at Scovill Mfg. Co.

Direct rolling of aluminum on the same type mill was described in 1936, as were experiments in direct rolling of steel. Later, Scovill installed a Junghans machine and by 1940 it was producing 1¼million pounds of metal a week, mostly in 7⅞-in. diam rods.

Then, in 1943 Scovill installed a Rossi-Junghans unit which casts brass cakes up to 180 in. or more in length. Bridgeport Brass began casting rod on an Eldred machine as early as 1933. By World War II virtually every major nonferrous producer in the country was using continuous casting and many steel companies were experimenting with it.

In 1950 Nichols Wire & Aluminum Co. introduced to the United States the Properzi machine which continuously casts aluminum in an equilateral triangular section ⅞ in. on a side at speeds above 30 fpm.

An early process (1937) was that of American Smelting & Refining Co. From the original 3-in. copper billet, the process has been improved so that various alloys and a wide range of cross sections are standard practice. Diameter limit has been about 6 in., but diameters to 9 in. may soon be available commercially.



-Titanium Metals Corp. of America

TITANIUM tetrachloride sample is drawn from chlorinator, early stage in making the metal.

NONFERROUS METALS...

NICKEL heat is deoxidized prior to tapping from a 20-ton electric furnace.

The International Nickel Co.



the present

IN the mid-1950's, the nonferrous metals are going through an industrial shakedown cruise. Patterns are changing significantly. The older, well established nonferrous metals are meeting aggressive marketing attacks of metals which have only recently become industrially significant.

There are new consumers for the nonferrous metals, too, industries that have sprung up in the past few years: Electronics; nuclear energy; automation, tied to electronics by computers; and others. Metalworkers are also learning more about giving metals desired properties and finishes as well as adopting new ways of forming metals into useful shapes.

◆ ALUMINUM has just clinched for itself the No. 1 spot among the nonferrous metals. Annual production capacity in the United States now tops 1.5 million tons. And, while no expansion matching the past 5 years is underway, producers are eyeing the situation with more new plants in mind.

Aluminum's basic properties enable it to do many diverse jobs. Foil is an example. Last year monthly shipments established new all-time records 8 times for a record high year. And '55 could top that since there has been considerable expansion of foil rolling capacity in the past year.

Other products with similar—though perhaps not so brilliant records: Nails, highway signs, light poles, electrical transmission lines, irrigation pipe, oil field pipe, fencing, hardware and even aluminum for "do it yourself" use. Of course, none of these come near the tonnage used by aluminum's main customers: construction, aircraft and automotive.

Construction now accounts for about a fifth of the aluminum consumed in the United States. The metal is used in applications ranging from farm and industrial roofing and siding to decorative store fronts; from door knobs to skyscraper cladding. Major reasons are its high heat reflectivity, appearance, corrosion resistance and workability. Incidental advantages accrue from its light weight — cheaper and easier shipping, handling, and erection.

New ships—both commercial and naval—are incorporating more aluminum in their design, particularly in superstructures. Objective is to reduce total displacement for more speed and lower the center of gravity for better stability. One problem here has been licked as shipbuilders learned better ways of electrically insulating joints.

Biggest recent development in the working of aluminum is use of extremely large extrusion and forging presses. Installation of these presses, which range up to 50,000-ton capacity, is currently being done under the Air Force heavy press program. They will produce larger aircraft sections, eliminating much of the join-

ing now necessary. This will cut costs and speed production and the aluminum industry has some ideas as to what presses of this sort may be able to do in civilian applications. Large OD extruded pipe is one and extruded automotive engine blocks is another.

Another field currently in for a lot of attention is finishing aluminum, especially vitreous enameling. Finding a frit usable at low enough temperatures was a major problem. Now there are reports of frits and processes for applying porcelain enamel to aluminum in forms from foil to castings. Other studies are currently under way to find entirely new finishes for aluminum.

◆ THE COPPER INDUSTRY has been faced with numerous difficulties over the past few years. These have ranged from political and labor troubles through supply-demand imbalance and price instability to consumer fears of eternal shortage. Result has been considerable research on substitutes for copper and its alloys. The industry has been hurt by this but it is fighting back.

Actually, the supply of copper raw materials is at least adequate. As the richer ore bodies are worked out, industry applies itself to an ever-widening base of leaner ores. As it becomes commercially practical to mine lower-grade ores, the supply increases because there is so much more of the poorer ore to be found.

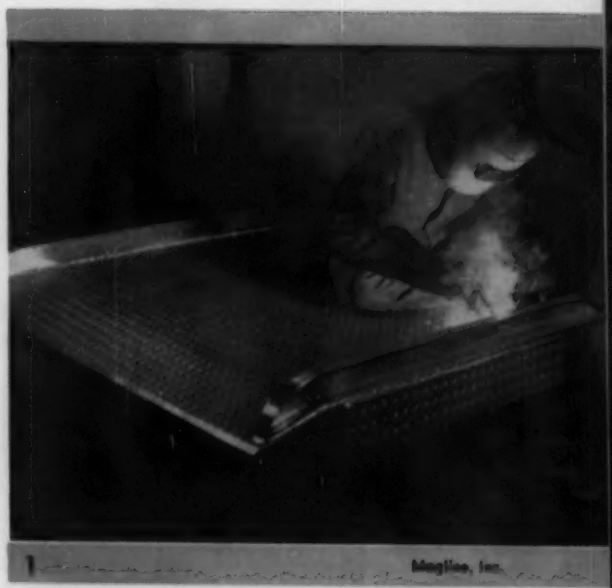
Fear of a long-term shortage has been caused by excessive wartime demand and other unusual calls for the red metal—such as the economic boom of 1953. These have been compounded by labor trouble in the United States, in Chile and in Northern Rhodesia; by the Chilean government's copper and monetary exchange policies; and by government stockpiling at times when consumers were facing shortage.

Copper's earlier price instability was another factor. When the market was rising or a shortage seemed near, buyers would try to stock up—and further tighten the market. When the market seemed ready to drop buyers would hold off—accelerating the drop.

The copper industry fought this by an almost unprecedented period of price stability, holding primary copper at 30¢ per lb from the time controls were lifted in February 1953 until the end of January 1955.

By banding together and taking their problems to Washington, copper producers and consumers have convinced the government of the advisability of a more realistic stockpile program.

The industry last year launched a campaign to bring the true supply picture to the public. And producers have accelerated their work in improving mining and refining methods for the lower-grade ores.





2

1 MAGNESIUM'S light weight makes it fine for dockboards, other materials handling jobs.

2 ZIRCONIUM is rolled into strip for atomic energy application, principal current use.

3 ALUMINUM rolling mill for wide sheets in Pacific Northwest. Mill has 120-in. rolls.

4 FORGING ALUMINUM on 16,500 ton press imported from Germany, installed at Cleveland.

◆ THE LEAD AND ZINC industry underwent a tremendous flip-flop in the past few years. Supply went from shortage to glut. Demand went from torrid to cool, then warmed up again late last year. The Korean shortage was overcorrected and many mines had to be shut down because of competition from imported metal.

Other factors accentuating the peaks and valleys of the market were the violently fluctuating prices of lead and zinc. As in copper, consumers would stock up when faced with a tightening market and stop buying when the market showed signs of easing.

The entire trade called for government help —though there were differences on what form the aid should take. Finally, in June 1954 the government came through with a revised stockpiling program.

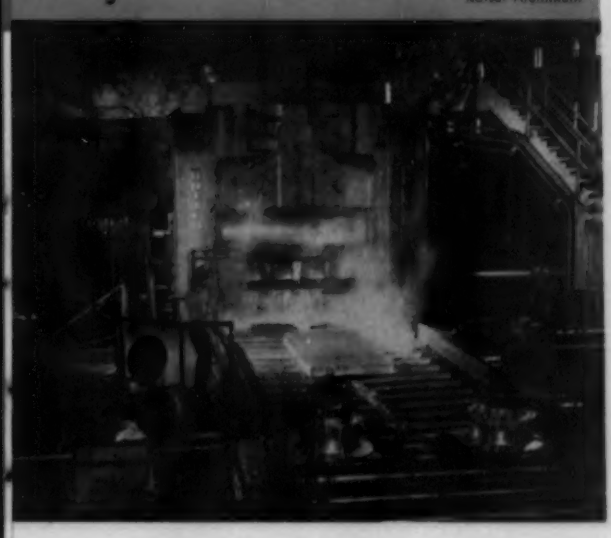
Strategic stockpiles of both lead and zinc were already deemed adequate by defense officials. The new program called for long-term stockpiling of materials which weren't considered critical with the buying to be done at the market price when there was a surplus.

This has helped to even out the peaks and valleys of the market. Not only did the government take up surplus production, it also guaranteed steady prices. Result was that consumers came back into the market for better tonnages.

Booming construction boosted zinc use for galvanizing and brass and lead use for various other building purposes such as plumbing and paint. Hot pace by the automotive and appliance industries took more zinc and lead. Lead's major uses, auto batteries and tetraethyl lead, were on more of a gradual increase.

Continued automotive trend to 12-volt

3 Kaiser Aluminum



4 Aluminum Co. of America



batteries is a healthy sign for lead but the really big boom from the Motor City is its heavy use of zinc diecastings in 1955 models. This year's cars use eight times as much zinc in their front end trim as the '54 models.

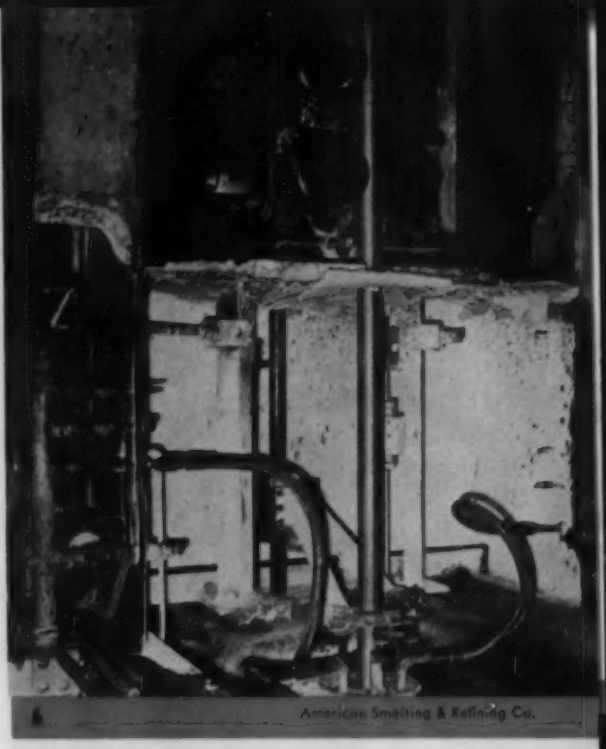
◆ MAGNESIUM is in an unusual position today. It was boomed by World War II, was just getting into the peacetime swing when the Korean war boomed it again.

Dow Chemical Co., is the only commercial supplier of the metal today. Dow operates its own Freeport, Tex., plant and leases the government-owned plant at Velasco, Tex. There are several other facilities owned by the government but none are now commercially producing magnesium and only one could possibly do it economically.

General Services Administration would like to unload these plants. The Justice Dept. which turned thumbs down on monopoly grounds when Dow offered to buy Velasco, would like to see additional firms in the business. Other members of the industry, including Dow itself, would also favor new suppliers. But nobody wants to get into the business.

Reasons are good, too. Most of the government plants are at least partially outmoded—though they'd be invaluable in an emergency. The Velasco plant is practically on Dow land, depends on the Dow Freeport plant. Construction of a new plant at today's prices would push overhead too high. And today's market doesn't even require the combined output of Freeport and Velasco.

But all is not bleak within the magnesium industry. As an industry, it sells magnesium where it can do a good job. Materials handling applications are a good case in point. Reasoning is that whatever moves or must be moved should be light. What better way to show all industry the advantages of magnesium?


American Smelting & Refining Co.

5 CASTING BRASS ingots by melting copper and zinc in Connecticut Valley electric furnaces.

6 CONTINUOUS CASTING unit producing copper base alloys in wide range of shapes, sizes.

7 BRASS COILS on conveyor of a four-high mill in a New England brass mill.

8 WAREHOUSES play major role in nonferrous metals distribution. Here bar is cut on saw.




Bristol Brass Corp.

Portable power tools, cameras, ladders, step-stools and the like do the same for the home-owner and his wife. Lightweight business machines using magnesium parts illustrate the metal's advantage for the businessman.

While magnesium was in a post-Korean slump last year, there was a significant advance in availability of wrought products with the initial commercial operation of Dow's mill at Madison, Ill. This added to advances made by Brooks & Perkins at its Livonia, Mich., mill.

One innovation of the Madison mill is the continuous casting of ingots weighing 2000 lb. This, plus the size of the rolling equipment, permits production of plates weighing up to 1800 lb and coiled sheets up to 72 in. wide.

The very existence of this plant will help magnesium sales. It makes wrought products available in sizes and quantities that users can count on. It should mean lower prices. And it is expected to help boost tonnage of wrought products above tonnage of cast magnesium—which the industry feels will be a sure sign of its acceptance as a mature metal.



◆ TITANIUM, though discovered in 1789, is a twentieth century metal. The commercial method now in use for production of titanium was perfected by Dr. Kroll of the U. S. Bureau of Mines in 1946. Actual output was insignificant until 1950 when some 60 tons were produced. But capacity since then has soared, standing over 7200 tons at the beginning of 1955, and with construction now under way which will bring it to 22,500 tons annually by the end of next year. Office of Defense Mobilization is currently thinking in terms of annual capacity about 3 times as great.

While the industry so far includes only one fully integrated company which starts with ore and sells mill products, there are at least five either producing or preparing to produce sponge and several others which buy sponge and sell mill products.

Widely ballyhooed as a "wonder metal," consumers have so far been slow to adopt titanium even in applications where it should excel. There are two reasons for this: (1) It costs too much for most potential users; and (2) there are still technical problems in its production and use. Considerable research is going into the solution of both of these problems.

Partly at the root of both is the current method of producing sponge. It is an expensive batch type process requiring the ultimate in precautions against contamination. While the substitution of sodium for magnesium in reducing titanium tetrachloride promises to reduce costs somewhat, it seems unlikely that the reduction will be enough to put titanium in the common metals class. Yet it is significant that the government contract with

Electro Metallurgical Co., which is building a 7500-ton-a-year sodium reduction plant, calls for buying titanium at the going market price, does not guarantee any minimum.

Metallic titanium has excellent corrosion resistance. Nevertheless, it is quite susceptible to hydrogen embrittlement in the conversion from sponge to ingot to wrought product. Some experts feel that delays between production of sponge and casting of ingots is a major source of this difficulty. More complete integration of sponge and ingot facilities is a suggested cure. Double melting, vacuum melting and vacuum annealing have also made significant advances in reducing the hydrogen problem.

As far as consumers are concerned, titanium mill products have not in the past shown a high enough degree of consistency from order to order. For this reason, and because many hesitate to design new materials into their products, titanium consumption has fallen far short of sponge production.

However, as soon as manufacturers, especially aircraft builders, are assured of a steady source of supply of unvarying quality, there will be new and wider applications.

One of the titanium industry's goals is efficient use of scrap metal in production of ingots. Currently, too many users are not segregating various alloys well enough and producers are engaged in an education program. Government goals contemplate the annual remelting of some 30,000 tons of titanium scrap.



9 Reynolds Metals Co.



10 General Electric Co.

◆ ALTHOUGH NO TIN is mined in the United States it is the world's largest consumer, tinplate being the major use. Recent research has produced thinner tin coatings and different thicknesses of coatings on opposite sides of tinplate.

The outlook for tin use seems to be a definitely rising curve. There are two reasons: (1) More things are going into cans; and (2) the population is rising steadily. Major market target of canners today is "soda pop."

Promising new fields outside the canning industry are tin-zinc alloy electroplating, aluminum-tin bearings, and phonograph records of aluminum, brass or steel with tin cladding.

◆ ZIRCONIUM AND HAFNIUM, almost twin metals chemically, show widely divergent nuclear properties which assure both a place in the atomic energy industry. The trick—because of their chemical similarity—is to separate them.

Zirconium has a high degree of permeability to thermal neutrons. Hafnium is the opposite. Trouble was that hafnium always showed up as an impurity in zirconium, ruining the



9 ALUMINUM FOIL rolling is fast growing field, will probably set another record this year.

10 POWDER METAL gears are put on mesh belt for sintering at U. S. Graphite plant.

11 LEAD container shields radioactive material at National Reactor Test Station, Idaho.

12 ZINC ore, coal and coke are distilled in this furnace. Flames are carbon monoxide.



latter's low neutron absorption property. But Atomic Energy Commission scientists found a way to separate them.

This discovery, plus zirconium's good physical properties and excellent corrosion resistance led directly to the metal's main use as a structural material for nuclear reactors. Hafnium, if it does become important, will probably be used for control devices.

Like many of the other "new" metals, zirconium's price is still far too high for industrial uses in significant quantities.

◆ WHILE BERYLLIUM was discovered in 1798 and isolated first in 1828, it is essentially a metal of the twentieth century. Its ability to age-harden copper was discovered in 1926 and for many years its major use was to improve the physical properties of other nonferrous metals via slight alloying additions. Copper is the main one of these, though aluminum, zinc, nickel, platinum and magnesium are also improved in certain ways by the addition of small percentages of beryllium.

Aluminum alloys of up to 50 pct beryllium have been developed, being suggested by the fact that beryllium is lighter than aluminum though slightly heavier than magnesium. They have excellent tensile and fatigue strengths but workability is not too good and cost is now prohibitive.

But today beryllium is getting considerable attention as metal in its own right. Primary reason is that it has unusual properties that are of value in the nuclear energy field.

◆ POWDER METALLURGY parts offer a number of economies. These savings come from: (1) Elimination or reduction of machining operations; (2) reduction in handling operations; and (3) practical elimination of waste metal in the form of machining scrap. Close dimensional tolerances can be maintained with relatively little trouble and few rejects.

Even though the job may begin with a somewhat higher-first-cost raw material in the form of powder, savings along the way in fabricating a well-designed part may actually reduce finished-product cost.

A part designed for another method of manufacture sometimes lends itself to metal powder fabrication with little or no change. Greater cost reductions and product improvements can often be effected by changing the design of sub-assembly machined parts so that they can be fabricated as single articles. When an entirely new part is created, powder metallurgy frequently permits savings by eliminating the need for machine tools, jigs, fixtures, etc., and also gets into production faster.

Beyond the savings in original costs, powder metal parts often outwear hardened steel because of their conformability, surface and oil retaining, self-lubricating qualities.

NONFERROUS METALS...

the future

WHERE WILL the nonferrous metals be when it comes time to write "200 Years of Metalworking"? A staggering question that can only be answered in small part, based on the past and present. No one in 1885 could have foreseen today's auto industry, supersonic aircraft, metal-clad skyscrapers, radio, television, atomic energy and the host of other onetime "miracles" that are commonplace today. These are all tremendous consumers of nonferrous metals.

IRON AGE readers of 2055 will be familiar with products and industries based on the discoveries of scientists still unborn. With the continuing acceleration of technology, it seems certain that the next 100 years will bring changes even more staggering than the past 100 years.

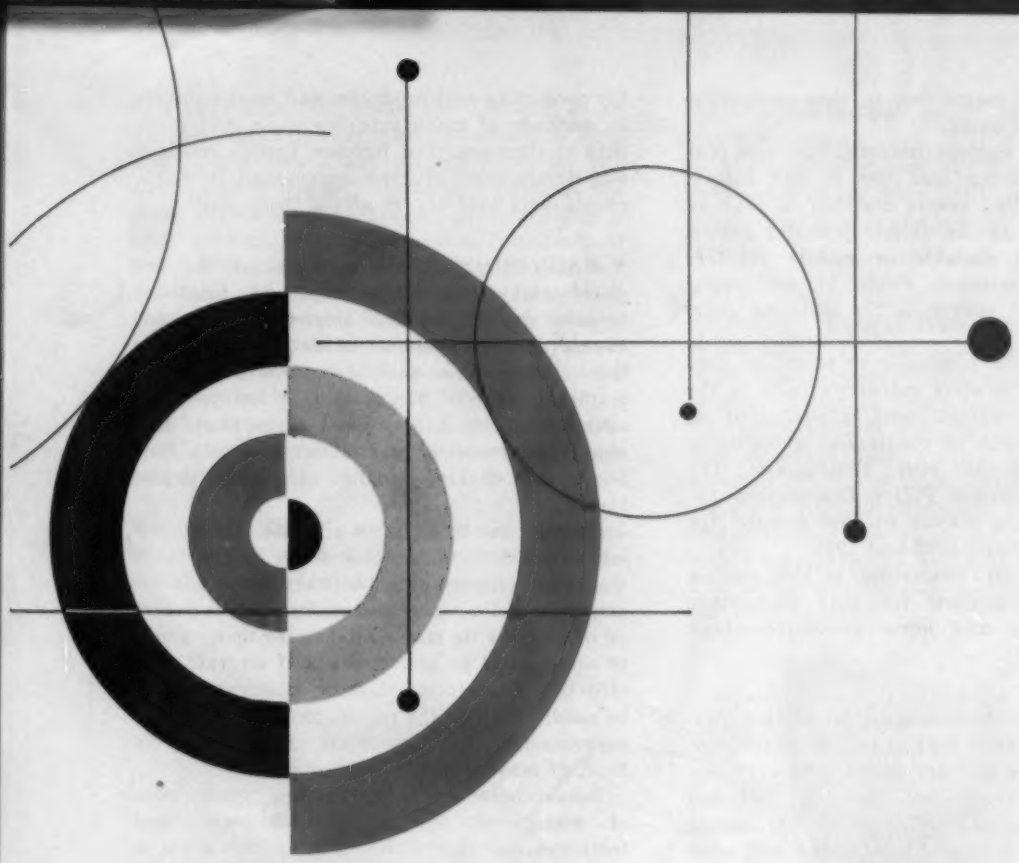
But on the basis of what we know today, of experiments in today's metal laboratories, here are some of the advances you can expect.

◆ ALUMINUM demand, according to the President's Materials Policy Commission, should grow to 4 to 5 times the 1950 total by 1975. Productive capacity in the U. S. has already doubled in the first 5 years of the 25-year extrapolation. Chances are strong that the Paley Commission was conservative as far as aluminum is concerned.

Aluminum ranks second only to steel today—and yet aluminum is still a relatively "new" metal which hasn't yet reached its full potential. Aluminum isn't primarily keyed to how well industry does from year to year. True, this does affect the light metal—but the major boosts of the past few years indicates that new products and new uses will be far more significant.

There is increasing use of the light metal for moldings and trim in today's cars. Automatic transmissions are made largely of aluminum diecastings. And many of Detroit's "dream cars" show more extensive use of aluminum for body panels and similar parts.

One of the dreams of the aluminum industry, a diecast aluminum engine block—or possibly



an extruded one—for passenger cars may also be in the picture. But possible switch to gas turbine power plants may leapfrog this development.

Another use that is just budding but that seems likely to flower fully in the future is the application of foil in advertising and packaging.

One of aluminum's next targets will be the can. Already in fairly widespread use for some products in Europe, there is a vast potential in this market for aluminum. High-speed joining of the can's seams is the major problem at present but it seems likely that this can be overcome.

The building industry is already a tremendous user of aluminum, taking about a fifth of the aluminum produced in this country. Most dramatic application in this field is the curtain-wall skyscraper.

One recent development that may have considerable importance in the future is aluminum-coated steel for outdoor use. A real battle between aluminum and zinc could grow out of this as it has in diecasting. And it could also give considerable competition to aluminum sheet itself.

◆ COPPER and its alloys have filtered into literally uncounted uses The metal has been known for so long that it isn't likely to displace any other materials in products now being made. Its future growth is keyed to new items for which copper's properties are suited and expanding demand for existing copper and copper alloy products.

The major property, of course, is copper's electrical conductivity, which accounts for more than half of the copper used today. Appliances, communications and electrical equipment, as well as the generation of power to operate them, are all slated for significant growth. And despite inroads by aluminum, copper will grow along with them.

The No. 1 trend in copper production is increasing use of lower grade ores. As this continues and as it becomes economically feasible to use ores of lower copper content, the raw material base spreads rapidly. While short-range dislocations of supply cannot be prevented, it seems certain that the long-term outlook is for at least adequate supplies.

◆ LEAD AND ZINC consumption in the U. S. will probably increase by 61 and 38 pct, respectively, between 1950 and 1975.

For lead, a 70 pct increase in its major use, batteries, is expected in the period. But many members of the lead industry feel that the really startling growth will continue to be in the use of lead compounds rather than the metal. Tetraethyl lead as a gasoline

additive is the major one in this category—but only one of many.

The growing nuclear industry will also play a part in boosting lead use in the future. Lead for shielding seems destined to play an important role as the atomic industry grows, particularly in portable or mobile reactors where other materials would be too bulky. Another use, of course, is for shipping radio isotopes.

As construction continues to boom, so does galvanizing. The steel industry's faith in the market for galvanized steel is evidenced by the terrific growth of continuous galvanizing capacity which is still continuing. The President's Materials Policy Commission envisioned a 50 pct growth in zinc demand for galvanizing between 1950 and 1975.

Zinc's No. 2 use, diecasting, is also making gains. Major markets for zinc diecastings are automobiles and home appliances—both are rising.

◆ TITANIUM, despite annual production running in thousands of tons, is still in its infancy. It is primarily a military metal with very few civilian applications. But once the technical problems are licked—and there's every reason to believe they will be—new vistas will open and justify the romantic labels that have been applied to it.

High strength, medium weight and excellent corrosion resistance definitely make it a challenger for many jobs now done by steel and other nonferrous metals. Good characteristics in the medium high temperature range give titanium a further advantage over the more common nonferrous metals and alloys.

How well titanium does in the future depends primarily on how low the industry can bring the price. At current levels, titanium is priced out of the market in all applications except those where none of the common metals can be used effectively. This, of course, is a technical problem. Titanium today is in a position similar to aluminum's position of 1885, just before the invention of the less expensive electrolytic reduction process.

Difference is that many well-equipped laboratories, rather than a single young man in a woodshed, are searching for the new method. It seems reasonable that an answer will be found. And that answer can bring a growth as staggering as aluminum's surge of the past 15 years.

But even if the big answer is delayed there is strong promise that advances in technology will edge the price downward in the nearer future. These advances will be: Improvements in current spongemaking techniques; ironing out the problems of converting sponge to ingot of consistently high quality; efficient use of scrap in ingot production; better techniques for producing mill products; and improvements in methods of manufacturing parts and products of titanium. The Defense Dept.'s research and development program, announced in April, should help industry to attain these goals.

◆ MAGNESIUM in the vastness of the sea itself gives this light metal its brightest promise for the future. Magnesium's present commercial raw material is literally inexhaustible. Every cubic mile of sea water contains 6 million tons of magnesium; a bathtub full contains about 2 lb. Thus, with the "ore" supply guaranteed, magnesium does not face any future choking because of mineral depletion.

Largest use today is in aircraft and guided missiles. With the outlook for a lengthy cold war and with greatest military emphasis on airpower and missiles, magnesium seems assured of at least its major market for many years to come. And as new methods of aircraft construction are developed, more magnesium may be used. Witness the recent construction of an experimental F-80 Shooting Star primarily built of magnesium instead of aluminum.

Researchers are also nearing their goal of magnesium alloys that will withstand temperatures over 600°F without too great a loss of strength.

Metallurgical uses of magnesium, second largest consumers of the light metal, are in for continual growth. Aluminum is in for tremendous growth itself and magnesium, as one of aluminum's major alloying ingredients, will ride along. Increasing titanium production, which requires magnesium on a pound for pound basis, will boost magnesium use, too, but this will probably be of only short term duration. The titanium industry is currently seeking ways of economically recycling magnesium in the Kroll process. There is also strong likelihood that the Kroll process will give way to some other in which magnesium is not used.

Actually, some of magnesium's less romantic current uses hold vast promise that is all but latent at present. Weight of anything that moves or must be moved is of importance—a factor that can be applied to a range of products from the kitchen to the factory and beyond. Magnesium already has established a beach-head in the materials handling field in the form of dock boards, loading ramps and tote boxes. This is certain to gain momentum.

Other areas that seem sure to provide growing outlets for magnesium include consumer products such as luggage and appliances. Its use is growing in printing plates, and for cathodic protection of other metals. Even the metal's main bugaboo, the inflammability of finely divided magnesium, could provide a major future use as a fuel.

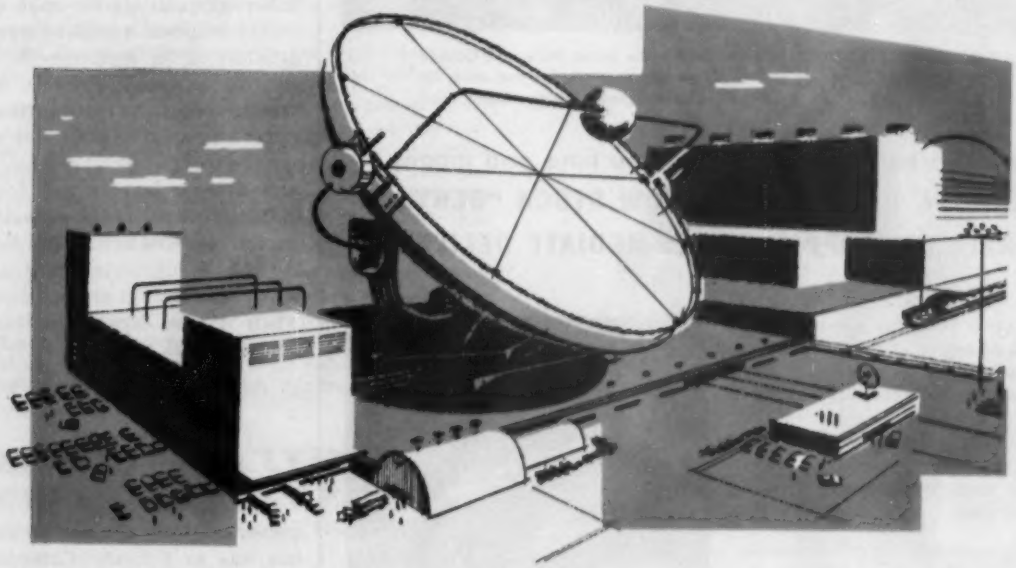
◆ MOLYBDENUM'S major use has been as an alloying agent in wear resistant steels, in alloy steel parts like gears and pinions, in tool steels, and to improve strength, toughness and wear resistance of cast iron. Metalworking is now using molybdenum disulfide lubricants at the rate of several hundred thousand pounds a year. As a metal, molybdenum has interesting high temperature applications. Early studies have shown that siliconized coatings would protect it from oxidation, permit operation for extended periods at 3200°F. Newer coatings will increase the temperature and time limits, should extend its uses in jet engines, rockets and missiles.

◆ SILICON AND GERMANIUM are among the lesser known metals which show promise. If its atomic structure could be properly modified, silicon could become ductile. Meanwhile its possibilities as a protective coating for steel, molybdenum, etc., are being explored. Germanium, though brittle and more expensive than silicon, may go beyond its present electronics applications into fields where its photo conductive and high thermoelectric power could be valuable.

◆ VANADIUM is one of today's less well known metals except as an alloying agent for steel. But it could blossom because of its association with uranium. Both are found in the same ore—and because of this association, vanadium production figures have been secret since 1947. Acceleration of the uranium program with private firms doing the work seems likely to result in considerable research into marketing vanadium. As a metal, it has excellent resistance to salt water corrosion at normal temperatures. It has good high-temperature strength but must be protected at elevated temperature. And it has some unusual electrical properties. These could easily pave the way for more extensive use but first the price of mill products must be substantially reduced.

◆ ZIRCONIUM appears to have an assured market as a nuclear reactor material because of its ability to pass through slow neutrons (and thus conserve them for their primary purpose of maintaining a chain reaction). In this property it is exceeded only by bismuth, lead and beryllium, which have structural qualities inferior to those of zirconium.

Future tonnage zirconium applications will center about its corrosion resistant qualities—both for nuclear and non-nuclear applications. The latter will depend on higher production and lower prices.



SOLAR FURNACE could well be an important unit in the nonferrous melting plant of the future. The large unit shown in the foreground could process difficult metals since solar furnaces will develop temperatures to 8500°F under an ideal sky.

Fast heating and cooling and absence of magnetic or electrical fields and furnace gases are advantages of the solar furnace.

Other metals would be melted by more conventional units, background, probably powered by a nuclear reactor as a steady source of low cost power. Continuous casting, rolling and extrusion will be highly developed.



LEADING NONFERROUS DISTRIBUTORS in the United States and Canada now maintain large stocks of "Berylco" beryllium copper strip and rod, ready for immediate delivery—an indication of the wide acceptance for this versatile alloy.

New marketing set-up saves you time and money

WAREHOUSE DISTRIBUTORS NOW STOCK "BERYLCO" BERYLLIUM COPPER FOR IMMEDIATE DELIVERY

Few industries these days have to be told about the advantages of beryllium and its alloys, particularly beryllium copper. The remarkable qualities of this alloy—its combination of strength and conductivity, its elasticity, its fatigue and corrosion resistance, its workability, its castability—have improved many old products, created many new ones.

And today, more than ever before, it looks as though beryllium copper is on its way to mass-production use. Raw materials, the Government says, are sufficient for both civilian and defense needs. The world's largest producer of beryllium copper, THE BERYLLIUM CORPORATION, has just completed a $2 million expansion program which will result in greater production, more forms, more sizes, closer tolerances, and, in some cases, lower prices. To top off this rosy picture, the appointment of a national network of distributors now makes popular sizes available for immediate delivery.

Testing samples are always available free of charge, and technical assistance is yours for the asking.



SUPPLIES OF BERYL ORE, raw material of the beryllium industry, are now more than adequate, according to the Bureau of Mines. An independent survey of world resources undertaken by THE BERYLLIUM CORPORATION drew the same conclusion.

BERYLCO ®

THE BERYLLIUM CORPORATION

DEPT. 5F, READING 6, PA.

STOCKED BY WAREHOUSE DISTRIBUTORS THE COUNTRY OVER

Quotes: 1855 —

Abstracts from past issues of THE IRON AGE, *selected for their flavor, and with some regard for whimsy:*

Platinum Coinage

The idea of platinum coinage continues to be a subject of discussion among the scientists of Europe. No other metal, not even gold or silver, possesses so many inherent qualities for such use. It would be proof against forgery on account of its high specific gravity; its scarcity gives it an intrinsic value, and its indestructible nature admirably fits it for standing the wear of constant use. It has already been largely used for medals in France, and successful experiments have been made for converting it into coin. In Russia it was used for coin previous to 1845, when it was demonetized by imperial ukase.

May 8, 1873

Copper Production

The production of the copper mines of Lake Superior for December was as follows: Calumet and Hecla, 2355 tons; Quincy, 260; Atlantic, 363; Franklin, 227; Allouez, 150; Huron, 120; Peninsula, 70; Hancock, 41.

Jan. 22, 1885

ACKNOWLEDGMENT

In addition to those mentioned in the text or in photo credits, the editors also want to thank the following for their help in preparing this section: Aluminum Assn., American Die Casting Institute, American Zinc Institute, Beryllium Corp., Climax Molybdenum Corp., Copper & Brass Research Assn., Copper Institute, Foote Mineral Co., International Tin Study Group, Lead Industries Assn., The New Jersey Zinc Co., Non-Ferrous Founders' Society, Phelps Dodge Refining Corp., Scovill Mfg. Co. and Tin Research Institute.



ASARCON CONTINUOUS-CAST BRONZES REDUCE COSTS, IMPROVE PRODUCTS

When you specify Asarcon Continuous-Cast Bronzes you specify lower manufacturing costs and improved operation for your products. Here's why:

Asarcon Continuous-Cast Bronzes are available in any length you need. You are not bound by the 12-inch or 13-inch standard lengths available in other types of castings. You can buy Asarcon Bronzes in exact multiples of your part length plus saw cut, leaving a minimum of scrap short ends. You pay only for the metal you use, not for scrap.

Asarco's patented continuous-cast process produces bronzes of exceptional uniformity. Impurities are excluded; alloys are free from porosity; hard and soft spots are eliminated. As a result, rejects are negligible. Fatigue characteristics are raised 33% to 100% and impact strength increased from 15% to more than double that of the same alloys produced by other casting methods. Parts made from Continuous-Cast Bronzes have longer life.

In the patented Asarco process, molten copper alloys are cast into rods, tubes and shapes in diameters from ½-inch to 9 inches in any size you need. The famous "Asarcon 773" Bearing Bronze (SAE 660) is in distributors' stocks throughout the country, ready for immediate delivery to your plant. Call the distributor nearest you, or write directly to the Continuous-Cast Products department of American Smelting and Refining Company.

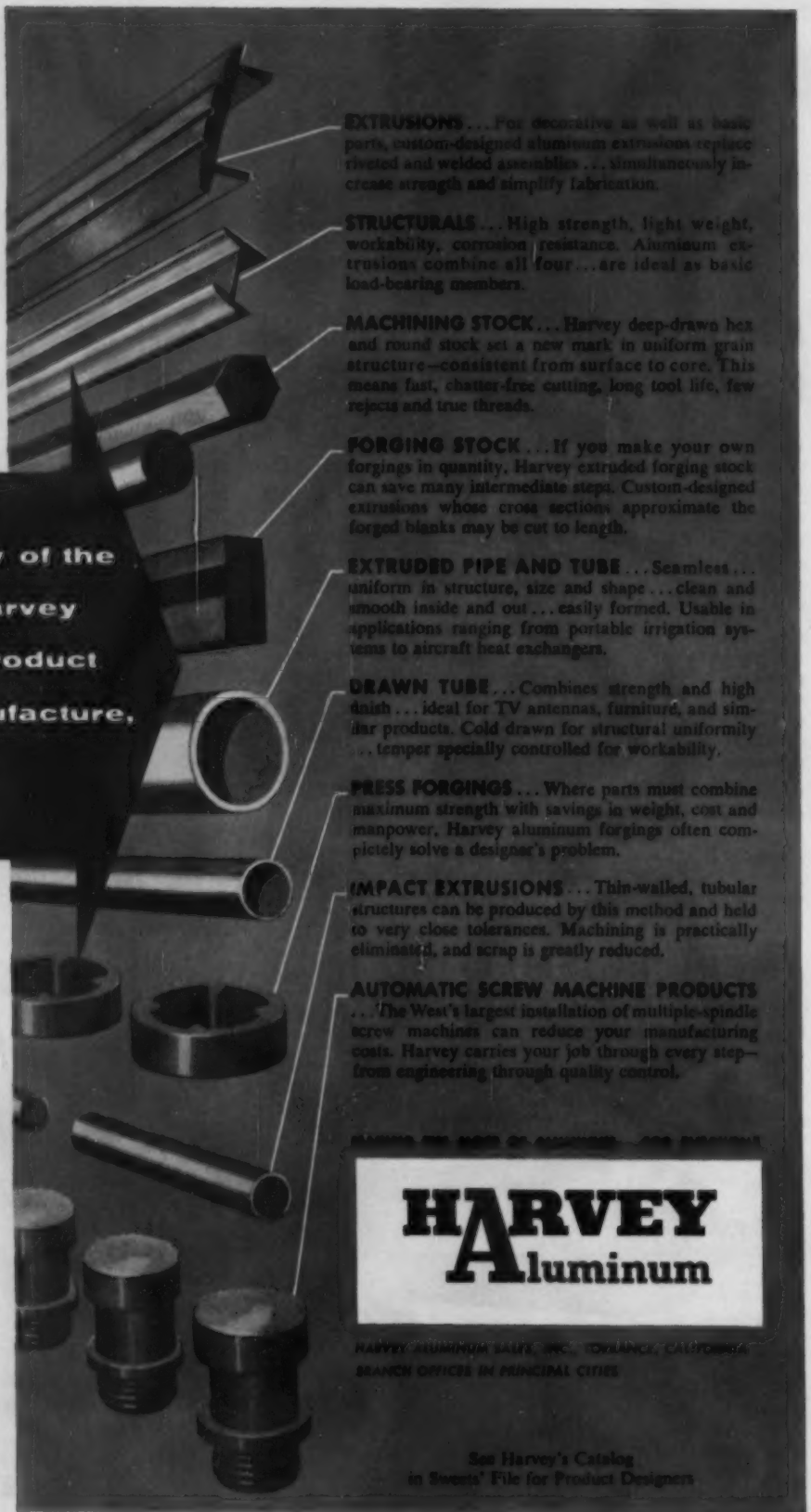
AMERICAN SMELTING AND REFINING COMPANY

Perth Amboy Plant, Barber, New Jersey • Whiting, Indiana

WEST COAST SALES AGENT:
Kingwell Bros. Ltd., 457 Minna Street, San Francisco

IN CANADA:
Federated Metals Canada, Ltd., Toronto and Montreal

How Harvey puts aluminum to work for you...



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EXTRUSIONS . . . For decorative as well as basic parts, custom-designed aluminum extrusions replace riveted and welded assemblies . . . simultaneously increase strength and simplify fabrication.

STRUCTURALS . . . High strength, light weight, workability, corrosion resistance. Aluminum extrusions combine all four . . . are ideal as basic load-bearing members.

MACHINING STOCK . . . Harvey deep-drawn hex and round stock set a new mark in uniform grain structure—consistent from surface to core. This means fast, chatter-free cutting, long tool life, few rejects and true threads.

FORGING STOCK . . . If you make your own forgings in quantity, Harvey extruded forging stock can save many intermediate steps. Custom-designed extrusions whose cross sections approximate the forged blanks may be cut to length.

EXTRUDED PIPE AND TUBE . . . Seamless . . . uniform in structure, size and shape . . . clean and smooth inside and out . . . easily formed. Usable in applications ranging from portable irrigation systems to aircraft heat exchangers.

DRAWN TUBE . . . Combines strength and high finish . . . ideal for TV antennas, furniture, and similar products. Cold drawn for structural uniformity . . . temper specially controlled for workability.

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HARVEY ALUMINUM SALES, INC., TORRANCE, CALIFORNIA
BRANCH OFFICES IN PRINCIPAL CITIES

See Harvey's Catalog
in Sweets' File for Product Designers

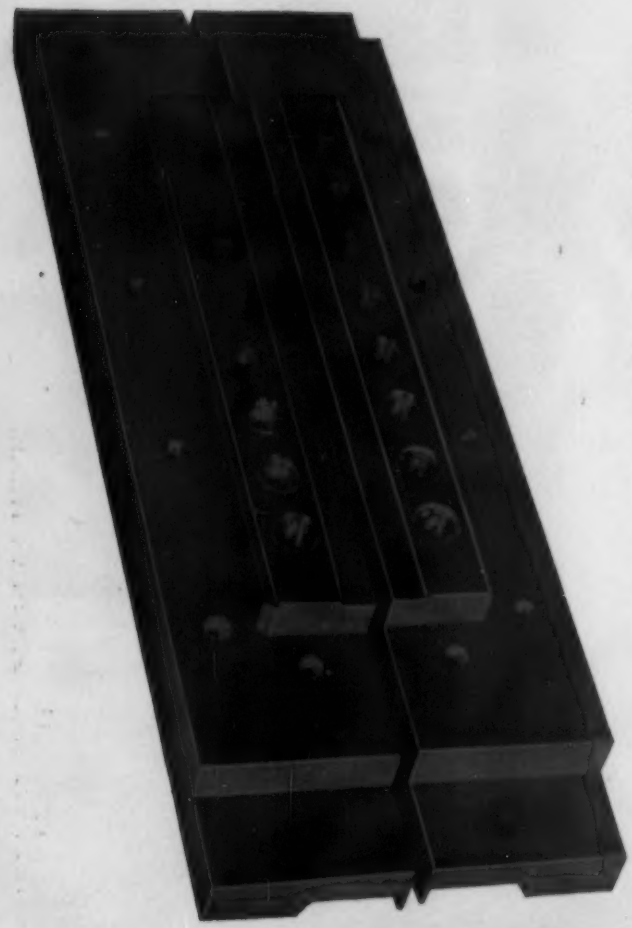
RESEARCH . . . DEVELOPMENT . . . PRODUCTION . . . Harvey does all three as a leading independent producer of aluminum extrusions in all alloys and all sizes, special extrusions, press forgings, hollow sections, structurals, rod and bar, forging stock, pipe, tubes, impact extrusions, aluminum screw machine products and related products. Also similar products in alloy steel and titanium on application.

REVERE

COPPER EXTRUDED SHAPE

SAVES

26% FOR TOCCO



Here is a "fishtail" and the Revere Copper Shape from which it is made. The part is a terminal block on a high frequency transformer, used in induction heating apparatus made by the Tocco Division of the Ohio Crankshaft Co., Cleveland, Ohio. Tocco is an important supplier of induction heating equipment to industry, which uses it for such diverse jobs as heat-treating and hardening, brazing, soldering, removal of gases from metal parts of vacuum tubes, vacuum casting, and heating before forging, upsetting, or other hot working.

The "fishtail" formerly was machined from solid copper bar, and on a typical run, the total cost for a certain number of pieces was $35,000. Revere studied the part with Tocco, and suggested that a shape would save money, even though the plain bar cost 10 cents less per pound. Actual experience produced these figures: total cost on the same number of fishtails, $25,700, a saving of $9,300, or 26.6%.

If your shop is machining plain rod or bar, it might pay you to consider the advantages of extruded shapes. Revere produces them in copper and its alloys, and aluminum alloys. Many design details can be preformed for you, provided they are parallel to the axis of extrusion. Revere would be glad to collaborate with you and see if shapes cannot save you money. See the nearest Revere Sales Office.



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Founded by Paul Revere in 1801

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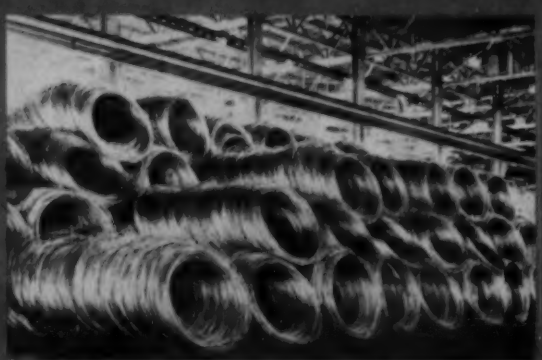
Your Alcoa Distributor is as near as your telephone, and his warehouse is stocked with the aluminum products you need for fast, economical production. His facilities include modern equipment for sawing, shearing and slitting stock to your specifications and for making prompt deliveries.



EXTRUDED SHAPES: For truck and trailer floors, thresholds, window sills, door frames, glass stops, copings, gravel stops, trim, channels, tees, zees, etc.



TUBE AND PIPE: Coiled tube; Alcoa® Utilitube; straight tube in round, square and rectangular shapes; heat exchanger tubes; standard pipe and pipe fittings; construction pipe; rigid conduit.



WIRE: Coiled and straight length; flattened wire; rivet wire and rod for die heading operations in manufacture of rivets, nails, bolts and screws.

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ALCOA® ALUMINUM

ALUMINUM COMPANY OF AMERICA

Your Local Alcoa Distributor Is Listed Here

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Birmingham
Hinkle Supply Company

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Ducommun Metals & Supply Co.
Pacific Metals Company, Ltd.
San Diego
Ducommun Metals & Supply Co.
Pacific Metals Company, Ltd.
San Francisco
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COLORADO
Denver
Marsh Steel Corp.
Metal Goods Corporation

CONNECTICUT
Milford
Edgcomb Steel of New England, Inc.

FLORIDA
Jacksonville
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Miami
Florida Metals, Inc.
Tampa
Florida Metals, Inc.

GEORGIA
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J. M. Tull Metal & Supply Co., Inc.

IDAHO
Boise
Pacific Metal Company

ILLINOIS
Chicago
Central Steel & Wire Company
Carey Steel Company
Steel Sales Corporation

INDIANA
Indianapolis
Steel Sales Co. of Indiana, Inc.

KENTUCKY
Louisville
Williams & Company, Inc.

LOUISIANA
New Orleans
Metal Goods Corporation

MARYLAND
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Whitehead Metal Products Company, Inc.

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Cambridge
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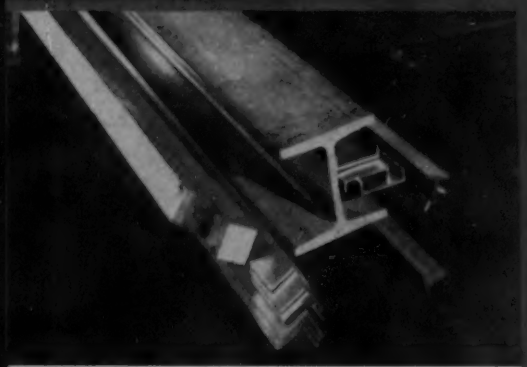
MICHIGAN
Detroit
Central Steel & Wire Company
Steel Sales Co. of Michigan

MINNESOTA
Minneapolis
Steel Sales Co. of Minnesota

MISSOURI
Kansas City, North
Marsh Steel Corp.
Metal Goods Corporation
St. Louis
Metal Goods Corporation

NEW HAMPSHIRE
Nashua
Edgcomb Steel of New England, Inc.

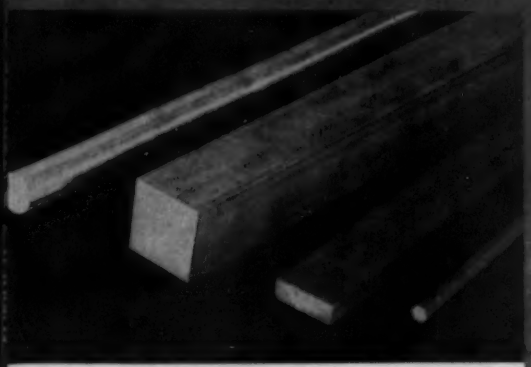
NEW JERSEY
Harrison
Whitehead Metal Products Company, Inc.



ROLLED SHAPES: Equal angles; unequal angles; channels; I-beams; tees; zees. Suited to a variety of structural applications.



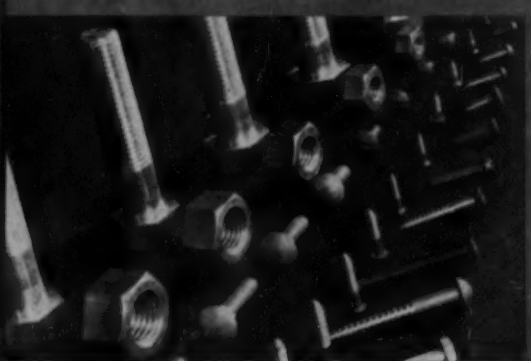
SHEET AND PLATE: Flat and coiled sheet; circles; patterned sheet; plate; tread plate; roofing and siding sheet; roofing accessories and fasteners; specialty sheet.



BAR STOCK: Square, hexagonal and rectangular in all commercial alloys. Rolled and cold finished to final dimensions for superior tolerance and finish.



SCREW MACHINE STOCK: Available in 2011-T3, the free-machining alloy, and 2017-T4, a higher strength alloy, plus 2024, 6061 and 7075.



FASTENERS: Machine screws, wood screws; washers; nuts; bolts; rivets. Recommended for fastening aluminum to prevent electrolytic damage.



WELDING AND SOLDERING: Welding and brazing wire; welding and brazing flux; solder flux; solder.

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Miller Steel Co.
Kenilworth
Kenilworth Steel Company
Newark
Parr Electric Co., Inc. (Conduit)

NEW YORK

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Eastern Brass-Mueller-Huntley, Inc.
Buffalo
Brass-Mueller-Huntley, Inc.
Whitehead Metal Products Company, Inc.
New York (L. I. City)
Adam Metal Supply Co., Inc.
New York
Eastern Brass & Copper Co.
Henry B. Lust (Circles)
Manhattan Brass & Copper Co.
Straits Aluminum Co., Inc.
Whitehead Metal Products Company, Inc.
Rochester
Brass-Mueller-Huntley, Inc.
Syracuse
Brass-Mueller-Huntley, Inc.
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Cincinnati
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Cleveland
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The great majority of bearing applications are suited to sleeve bearings. There are uncounted uses for them in all types of mechanical equipment. So, Johnson Bronze produces a great variety of sleeve bearings for these multitudinous applications. You will find industry's widest range in the Johnson line . . . various alloys, bronze, babbitt and aluminum, and different combinations with bronze and steel. The sizes range from tiniest bearings up to King Size, 14" OD and 17" long. They are economical in first cost and in operation, and in most cases will give service for the life of the equipment in which they are installed. Since Johnson produces all types of sleeve bearings, their engineers can give you unbiased advice on the bearing best suited to your application.

JOHNSON BRONZE COMPANY
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JOHNSON JB BEARINGS
Sleeve-Type

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40 YEARS
at quality metals . . .
1959 marks 40 years of quality alloys by Titan metal specialists. Brass and bronze freecutting rod, extruded brass shapes, bronze welding rods, brass wire, aluminum and brass hand screw-machine parts, brass pressure die castings, brass, bronze and aluminum forgings are produced to meet high standards and rigid requirements. Titan Metal Manufacturing Co., Bellefonte, Pa. Offices and agencies in principal cities.

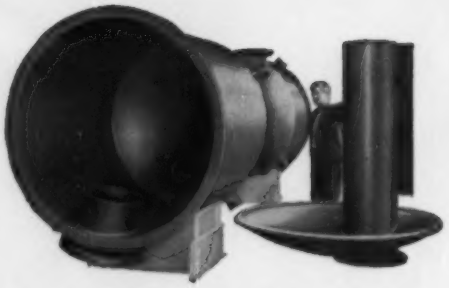
Stainless Steel Fabrication by KIRK and BLUM

With 48 years of experience in the field, KIRK & BLUM offers quality workmanship, economical fabrication to the most exacting specifications . . . large or small quantities.

Stainless fabrication, whether for chemical, process, food or other industries, is quite different from conventional steel working. KIRK & BLUM engineers and workers have the special knowledge and techniques to do an outstanding job. From the selection of the proper alloy for specific corrosive conditions, through handling and preparation of material and prevention of contamination, special care is taken.

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Literature on Request:

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"ELECTRICAL ENCLOSURES"

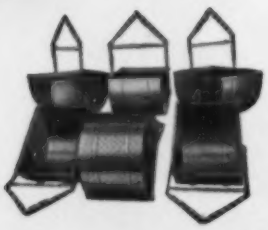
THE

KIRK AND BLUM MANUFACTURING COMPANY

3200 Forrer St.

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KIRK & BLUM

ALLOY FABRICATION



Joe Vuille says it's simple arithmetic:
"180 cups per min. x 60 min. x 40 hours per week x 5 weeks=

2,160,000 brass cups in one uninterrupted run"



From the cup illustrated actual size above, socket shells are produced in eight operations on special equipment, followed by a stress-relief anneal and a final bright-dip.

Socket shell cups like this are formed in an 8-operation multiple-plunger press at the rate of 86 per minute.

Typical of Leviton's complete line of lampholders is this "Electrolier Push Thru" model. Both shell and cap are made of ANACONDA Brass.

For more than 20 years, Joe has been pressroom foreman of Leviton Manufacturing Company, Brooklyn, N. Y., one of the world's largest manufacturers of electrical wiring devices.

Multi-million production runs of stamped and drawn products are nothing new to Joe, but he'll admit that there's more to it than a multiplication table:

"First," says Joe, "you start with a good product design. Then the toolroom calls on its broad experience in diemaking. Next, good equipment and good housekeeping are essential in the pressroom. And then there's the brass: these extra-large coils of brass strip have to be just so . . . in dimension, composition, grain size, temper and surface finish . . . lot after lot after lot . . . tailor-made for the job."

Each year Leviton uses many thousands of pounds of ANACONDA Brass, produced to Leviton's precise specifications, "just so . . . lot after lot after lot . . . tailor-made for the job." Perhaps we can perform a similar service for you? Write to *The American Brass Company, General Offices, Waterbury 20, Connecticut.* In Canada: *Anaconda American Brass Ltd., New Toronto, Ontario.*

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METALINE FALLS, WASHINGTON

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100 YEARS OF METALWORKING



PRESSWORK 1855 1955

AMERICAN INDUSTRY in 1855 was called upon to satisfy the enormous appetite of a growing nation for manufactured goods. The year marked the mid-point of the opening decade of a new era—an era of mass consumption. The country's growing awareness of its strength as a nation, the rapidly expanding agricultural and industrial economies, and the extraordinary ingenuity of American inventors and businessmen provided powerful stimuli for industrial development.

The power press, "relatively crude but miraculously right," offered a more efficient instrument for the mass production of metal products. The basic form of the power press was established.

Much of the sheetmetal working industry of 1855 still used the methods of the craftsman. Silversmiths, coppersmiths, and blacksmiths coaxed metals into shape. The limits of drawing and bending were not fully understood. Such presswork as existed was generally confined to the softer metals.

One of the first machines developed in this country for sheetmetal work was a bar folder for making tin wear. The machine was invented by Edward Converse in 1806. A cornice brake is reported to have been developed in Cincinnati about 1840.

By 1855 a few men had begun to understand the implications and the methods of mass production. In Pittsburgh, railway spikes were produced at the rate of 50 per minute. Nail-making and riveting machines were widely used. The first American made wire-nail machine was built in 1851. Buttons, pins, hooks and eyes were produced in quantity. Clock faces were blanked and formed in a stamping press.

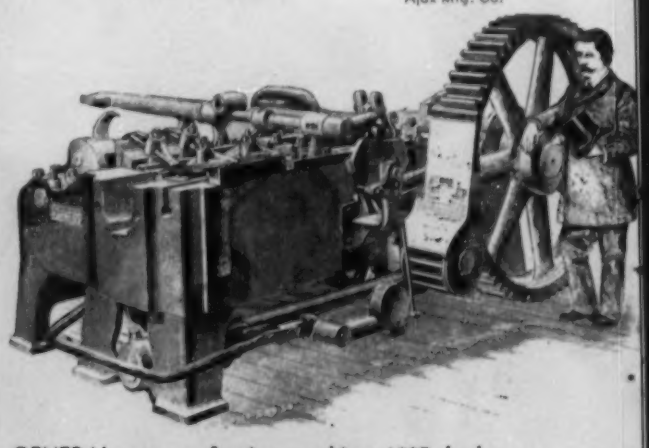
Power presses of 1855 were lacking in me-



Mullins Mfg. Corp

PRESSFORMED sheetmetal for architectural use was a big item around the turn of the century.

Ajax Mfg. Co.



GENERAL purpose forging machine, 1885, had a cast iron bed frame and cast iron crankshaft.

chanical refinement. Early presses were stopped by running off the belt. Perfect control of the machine was difficult, because of overrun, and continued high production was impossible. One of the first major developments was the automatic stop which insured disconnection of the wheel from the shaft after one revolution. This gave the operator greater control over his machine and reduced a major source of damage to tools, machines, and parts. Another significant development was the eccentric adjustment, by Stiles and Parker, which insured adjustment of the punch to a high degree of accuracy.

Perhaps the biggest problem early press builders faced was to keep up with the demands of press users for bigger, more powerful and more accurate presses. These problems were met between 1860 and 1890 by building presses of greater accuracy and with greater rigidity in slides and cranks, and with improved bearings.

Development of power presses has been largely influenced by the wide consumer, industrial and military demands. Growth of the sewing machine, availability of low-cost kerosene for lighting in the 1860's and the subsequent need for cans, wide public acceptance of the bicycle, use of cans for food, the metal cartridge, the automobile all strongly influenced press design.

Improved presses met new needs

As early as 1839 a 7-ton tilt hammer had been set up at West Point to forge 17 in. diam shafts for U. S. battleships. By 1855 forge shops had sprung up in New England, along the Atlantic coast, and in the Great Lakes areas.

Introduction of the Bessemer process in 1864, and its general acceptance by the steelmaking industry, led to rapid displacement of wrought iron by steel. The forging equipment satisfactory for wrought iron was generally inadequate for the satisfactory production of steel forgings. Many companies during this period pioneered in the production of high grade forgings. The result was a demand for improved forging presses.

In 1883 Congress authorized study of plans to establish a plant for the manufacture of heavy ordnance. As a result, a plant was established at the Bethlehem Iron Co. to make heavy forgings and armor plate. A 7000-ton forging press was built by Sir Joseph Whitworth & Co., Ltd., along lines of a 5000-ton forging press used in England.

The hydraulic forging press was introduced into the U. S. about 1887. One of the first double acting steam hammers was built at Midvale, Pa., in 1888.

Drop forging has been largely an American development. The crank drop invented by E. K. Root in 1850 to replace his screw drop aided substantially in the development of drop forging. First commercial die forging is believed to have taken place about this time. Later, development of the friction roll drop considerably enlarged the usefulness of these machines by providing control of length and speed of stroke.

One of the first sets of closed impression dies is described in a patent filed by C. E. Billings, Utica, N. Y., on Dec. 14, 1861. The dies were designed for production of a "defensive weapon."

Upset forging, referred to as hot-heading or machine forging, had its origin in the bolt industry and railroad shops. The process was well developed by 1885. One of the first general purpose forging machines built at this time had a cast iron bed frame with bolted on legs, a cast iron crankshaft, and was equipped with a drop lock, or glut type of stop motion to permit the handling of heavy work into and out of the dies. During the 1890's forged steel crankshafts came into use.

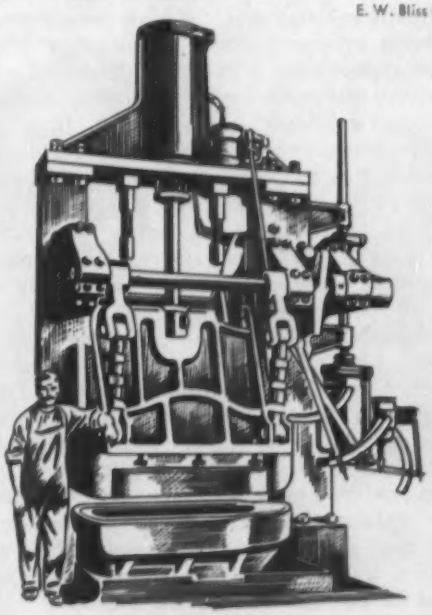
The principle of the draw ring, an early European development, was one of the great forward steps in the pressworking of metals.

A French press, using levers and weights for blank holding was introduced here about 1860. Mechanical drawing presses of various types appeared after 1870.

Early drawing operations were largely confined to the softer metals. In 1868 an American patent was issued to J. H. Cole of Millbury, Mass., for a die and plunger for making thimbles or ferrules from cold wrought iron. The pieces could be formed by one impression or stroke of the press as "fast as anyone can place the disk of iron in the die." Based on this patent, production of wrought iron ferrules was begun about 1869.

FIRST SEAMLESS hot-drawn bathtub, made over 50 years ago, was produced on press of this type.

E. W. Bliss Co.



Cam drawing presses were built around 1859 in this country. By 1880 there were a half dozen types and sizes. Some of the earliest double action presses were underneath driven machines. After 1880 the under drive types with pull-down punch slide and cam-lifted blank holder began to disappear.

Open rod frame construction, used around 1880 was later abandoned because of sway and stretch in the columns. The walking beam press has given way to other designs. The toggle mechanism, as a means of actuating the blank-holding slide, began to appear between 1887 and 1890. The simple principle was sound and has survived with little change.

Triple-action presses developed

Development of double crank toggle presses lagged behind the single crank type until the demand for large area auto body stampings was felt. The twin drive, for shaft and blank-holding mechanism, was introduced about 1912 to divide torsional load on these parts. From this followed the development of the large mechanical presses used in the stamping industry.

Early in the history of drawing sheetmetal the need for three operating motions was evident for some jobs. As a result the triple-action mechanical press was developed.

Hydraulic presses have always offered the advantages of tremendous power, great flexibility, and close control. Their slowness of operation, however, confined use of hydraulic presses for many years to forming of large, heavy, and deep-drawn parts. Despite their obvious advantages, they could not match the speed of mechanical presses. Hydraulic presses continued to develop rapidly, however, for the many applications where their special advantages could not be matched.

Greater control of pressures and ability to adjust stroke for depth of draw gave hydraulic presses greater flexibility for quantity production applications. About 1922 high-speed rotary delivery pumps that could be directly connected to press cylinders were developed. During the 1930's improved controls became available. This combination added tremendously to the versatility of the hydraulic press.

With improved design, space requirements were reduced and operating speed increased. Hydraulic presses began to be more widely used by all industry.

Modern roll forging had its beginning in the latter part of the nineteenth century. The method was used for rolling spindles of carriage and wagon axles, eliminating the operation of drawing the axle under the hammer. Agricultural implements and silverware were also produced in this manner. As the automobile replaced the wagon, the use of the forging roll was extended to rolling automobile axle shafts. During World War II forging rolls were used for preforming propeller blades.

Extrusion of preheated lead for making pipe in screw operated cylinders is reported about 1797. From this developed the use of powerful presses for hot extrusion of rods, tubes, and shapes of varying cross-section in tin, lead, zinc, copper, brass, aluminum, steel and titanium.

Extrusion of lead sheathing on electrical conductors played an important part in extrusion development. In 1879 presses for extruding lead sheaths directly onto cable were developed in Europe. Improved American presses capable of performing this task were introduced in 1880 and 1885.

Advances during the past 50 years have permitted extrusion of high-melting point metals. These developments include increased press sizes and development of steels capable of operating under continued high heat and high stress.

Extrusion of aluminum has grown rapidly in the past 25 years. Greater pressures available in modern presses since 1940 have also permitted extrusion of zinc.

Development of the Sejournet process, using fiber glass as a lubricant, has made possible the hot extrusion of steel. Recent studies indicate the extrusion of carbon, low-alloy and stainless steels, and of titanium will be economically practical.

About 1841 a patent was issued to John Rano for making "vessels so constructed as to collapse under slight pressure and thus force out the liquid therein, through proper openings, for that purpose." This was the start of impact extrusion. A screw press was used to form the tube from a cold metal blank. The process, used commercially before 1855 in Europe, was introduced in America about 1870.

Stretch forming awakens interest

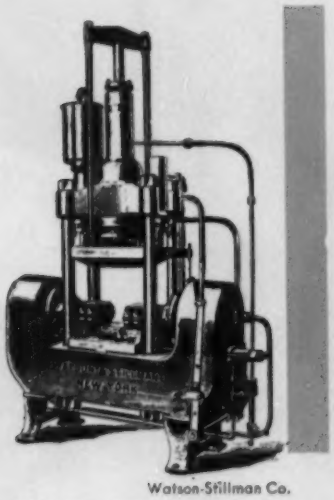
Most soft metals (lead, tin, and their alloys) have been impact-extruded for many years. Use of tin for collapsible tubes, once a big item, has been largely replaced by other materials. Commercial production of impact extruded aluminum products began about 1920.

Cold extrusion of steel had its origin in Germany. Recently the process has been developed commercially in the United States for the production of a variety of shapes.

World War II brought stretch forming methods into the limelight for production of aircraft parts. Stretch machines for this purpose had been used in Germany during the early 1920's. Soon after, American manufacturers began to produce machines working on similar principles.

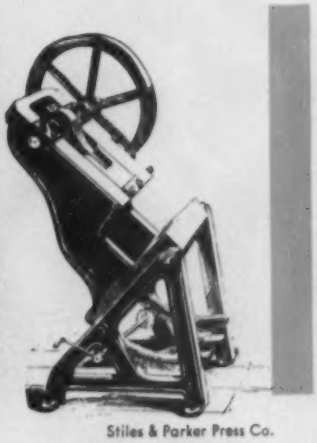
Plastic dies, a very recent development, have awakened tremendous interest among tool designers. They offer low tool cost for short run production.

Present day high-speed and highly automated press operations have a long history.



Watson-Stillman Co.

TRIPLE ACTING hydraulic press—priced at $1000 in 1895—formed small parts from sheet, bar iron.



Stiles & Parker Press Co.

ADJUSTABLE BED press, built about 1872, was designed to eliminate an early handling problem.



Stiles & Parker Press Co.

DOUBLE ACTING drawing press. Cam on lower main shaft moved slide up to cut and hold blank.

Early press makers were acutely aware of the need to eliminate handling and speed press operations.

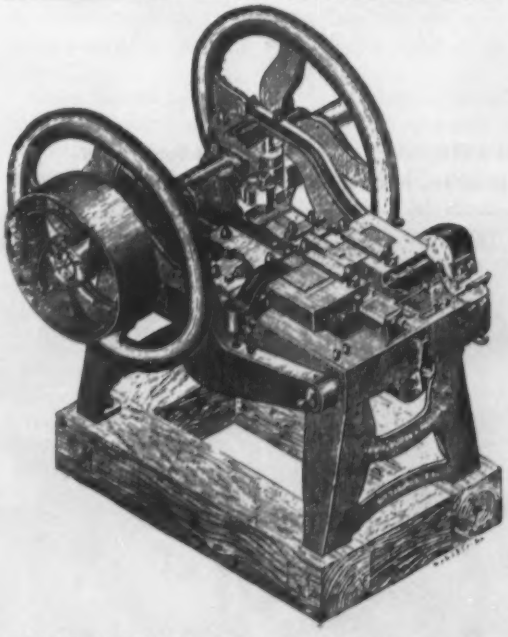
The inclined press was developed to eliminate a handling operation. While a patent for an adjustable inclined press was issued in 1872, inclined presses had been in use for some time. The inclined press, which permitted the work piece to drop out of the press, was especially useful where the finished part was ejected from the top of the die.

Earliest mechanical feed is believed to have been the coin feed on a French coining press set up in the U. S. mint in 1836. The first of these presses, built in France in 1833, may also have been the original knuckle joint press. By 1885 automatic feed roller attachments, automatic slide feeds, and automatic pushout attachments were available to press users. An embossing press used then, utilized a slide in an extra bolster to permit the embossed piece to fall out beneath the press. In the years that followed, a host of handling devices were put to work by press users. They became standard equipment and led to the high mechanization we know today.

An automatic friction belt feed on a cup redrawing press was offered by one maker about 1881. A rotary feeding device, located on a stud set in the bed of the press, was developed between 1880 and 1890. The plate had a number of recesses to receive lower dies, all of which fit the upper die. Work was placed on the lower die and as an automatic ratchet feed brought each piece around, the upper die formed the part. The piece moved on and finally dropped through a hole in the bed of the press into a box. In more recent years, mechanical hands and other ejection and feeding devices have extended the range of pieces which may be handled in and out of the press.

Progressive dies were well developed by 1900. Automatic can making machinery developed from early presses during the 1890's. Such automatic machines were linked together with conveyor systems about the turn of the century to initiate the modern automation idea now widely used throughout industry.

Lewis, Oliver & Phillips



BOLT MACHINE, advertised in The Iron Age in 1873, would "do more and better work."



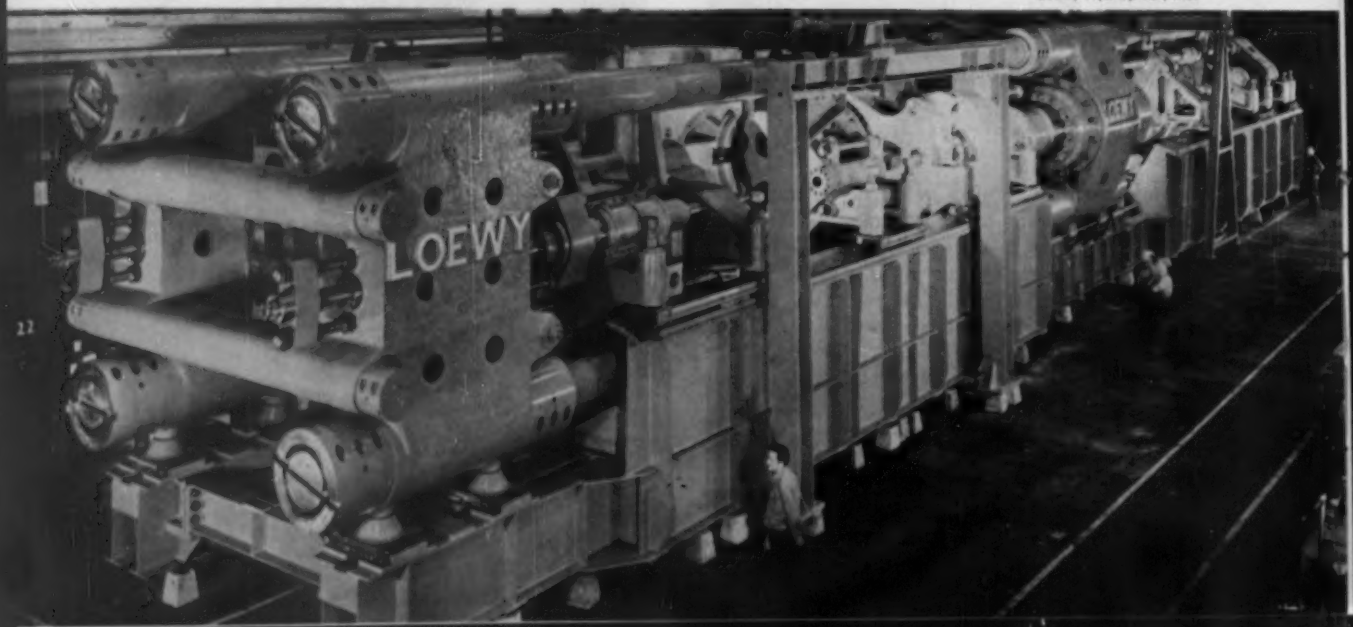
CLOSE TOLERANCED steel parts are cold extruded on these big hydraulic presses.

Mullins Mfg. Corp.

PRESSWORK

GIANT EXTRUSION press, part of Air Force heavy press program, has capacity of 8000 tons.

Loewy-Hydropress, Inc.



the present

PROGRESS in a typical large, modern pressed metal shop may be summarized in the changing speeds of press operation. Only 6 years ago, most big presses were capable of making large stampings at a rate of only 6 strokes a minute. Today, big presses with new automatic materials handling devices, operate all day long at from 12 to 18 strokes per minute. Meanwhile, recently built presses, operating at 12 strokes per minute, for example, may have drawing speeds as low as 42 ft per minute. While the production rate of large presses has more than doubled, drawing speeds have been reduced by a third or more. As a result, more parts of higher quality are produced with less scrap.

Improved press design including better bearings, better lubrication and greatly improved clutches have contributed to the progress. However, improved motion of the latest presses is probably the most important single factor permitting the doubled and tripled production of large stamped parts.

Very large presses in automobile body plants, with automatic feeding and ejector equipment, operate at speeds up to 18 strokes per minute. Line presses involving shallower draws are operated at an even higher rate—up to 25 strokes per minute.

More efficient press loading devices eliminate much of the drudgery and danger in a modern press room. These devices have contributed significantly to improved efficiency in the press shop. Process engineers and suppliers of automatic handling equipment have, of course, gone far beyond the original feeder designs of a few years ago. New gravity feeders, reciprocating devices that push the blanks into the die, and catapults have been installed on a number of lines.

Gage blocks and nesting blocks, often built into the forming dies, have increased reliability of automatic press feeders and ejectors. Special neoprene rollers avoid scratching of parts. Pressed metal experts have learned just where to put tabs or extensions on stampings to facilitate feeding, location or ejection.

While plans for automatic handling are beginning to get more consideration in large scale press operations, it is still necessary first to make a satisfactory part. To the extent that variations or allowances for automatic processing do not interfere with forming a satisfactory part, such considerations are entering more and more into current planning.

Where line press operations are involved, it is natural that automatic programming should get more attention from all plant department heads. In many large volume shops, automatic handling has become a major consideration in laying out the press line. Auto plants have learned to make both outer and inner door panels as well as outer and inner rear deck

panels on the same automatic line with only minor changes. As has been true in the past, both right hand and left hand parts are often produced on the same press line.

The steadily increasing cost of dies resulting from higher labor costs and the growing complexity of metal forming dies has forced die engineers to take every available opportunity to economize.

Through increased use of jig boring and standard die sets, important cost savings have been realized. Use of sectional dies often simplifies die construction, handling and heat treating. However, the rapidly increasing use of progressive dies, requiring much greater precision and the use of many built-in safety features has tended to send tooling costs soaring. Dies for the newest transfer presses are becoming even more complex and more expensive.

Precision is the key to die construction today. Dies are designed to take full advantage of the remarkable accuracy of modern jig borers and jig grinders. By machining several mating die components at a time in modern precision equipment necessary accuracy can be achieved. Many dies used for progressive forming now approach the accuracy of gages.

The insertion of guides, ejectors, limit switches, spring pilots and necessary safety devices in automatic progressive dies adds to the high cost of dies.

Plastic tooling draws wide interest

Low cost plastic tooling is taking on more jobs. Potential savings are large. Dies can be built quickly to save tooling time. A major motor car producer has used plastic tooling to make 17 different stampings.

The new plastic dies appear to work best on light gage material. Despite considerable experience, it is hard to predict with certainty the life of a plastic die in production. Auto plants are experimenting constantly with plastic tooling but are inclined to assign it to comparatively short run applications like sport cars, trucks, buses or stampings for export.

A new hard surfacing material for plastic tooling has contributed to longer die life although experience is too limited for accurate evaluation. Plastic dies have already achieved considerable success in the aircraft industry. Forming of more than 10,000 aluminum stampings with a single set of tools has been reported by several airplane firms.

Another interesting development is the combination of plastic and a zinc alloy, Kirksite. Such a die designed to produce an auto luggage compartment cover panel saved 25 pct in time and 40 pct in production costs. Use of plastic with filler materials such as iron filings has shown promise.

The ability of properly designed and mounted carbide dies to produce long runs of remarkably



1 Hufford Machine Works Inc.



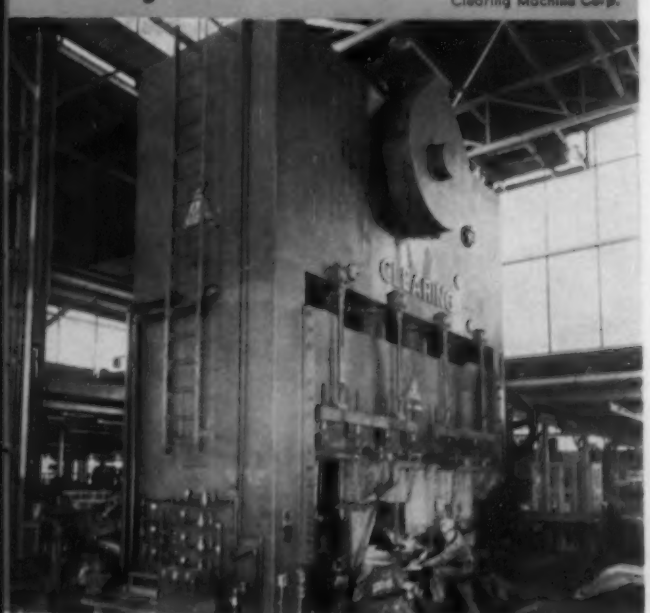
2 Danly Machine Specialties, Inc.

1 RADAR SCANNER reflectors are preformed two at once from 61S aluminum on this stretch press.

2 PRODUCTION of electrical laminations and other stampings is entirely automatic on this 150-ton press. Coil stock is power fed to press. Where skeletal strip is left, cutter chops up strip.

3 LARGE AUTOMOTIVE dies are spotted in this 750-ton press installed in a busy Detroit die shop.

3 Cleering Machine Corp.



accurate parts is well established. Carbide dies will produce a hugh volume of electric motor laminations before redressing.

Carbide dies may be used for forming, coining, piercing and blanking. Rings for draw dies are another growing application and the size of carbide pieces is also growing rapidly. Single solid pieces of cemented carbide weighing more than 4000 lb are now produced in a hot press setup. Here large carbide die sections, rolls for rolling steel strip, large punches for cold extrusion work, and large wear resistant linings for brick molds and many other uses may be produced.

Press forging makes rapid gains

The use of stretch techniques, rubber pads and hydraulic fluids for metal forming continues to interest a number of metalworking plants.

The Guerin rubber-die process and stretch-forming first came into prominence during World War II. Neither process has had wide application outside of the aircraft industry.

Using fluid pressure to form metal stampings is not a new idea. This development grew out of the never-ending search to eliminate one of the minimum of two dies ordinarily required to form metal in a press.

Probably the most important single forging development during the past decade is the rapid gain made by press forging. Where operating conditions justify, there are many advantages to a press forging installation, including ease of training operators, high production, low maintenance, adaptability to automatic handling and, in many cases, long die life.

The modern Dodge Forge plant of Chrysler Corp. offers an example. In this installation, billets for crankshafts are inserted in the heating furnace automatically. Heated billets are also removed automatically from the furnace. A conveyor carries the billets through reducer rolls which establish proper grain flow and reduce the amount of work to be done in the forging dies. Only a limited manual effort is required to complete the entire operation from billet through heat treatment and shot cleaning to forged and cleaned crankshaft.

Except for minor changes, the new Chevrolet crankshaft forge plant at Tonawanda, N. Y. will have virtually the same kind of operation.

Press forging has already obtained a considerable foothold in the big, volume production forge shops. This trend is expected to spread to other segments of the industry.

Despite its remarkable versatility, drop forging does not lend itself readily to automatic billet handling. However, in the hands of a skilled operator, drop forging is a thoroughly reliable and highly valued process. Its flexibility alone recommends it for many applications. For this reason, drop forging will be used for

many forging applications for a great many years to come.

The attention forge operators give to the cost of downtime and maintenance has brought forging hammers prominently into the competitive picture. Particularly in big volume forge shops, downtime may be very costly. Use of spring or snubber mountings, in addition to reducing shock, lowers maintenance cost. Less noise and elimination or sharp reduction of foundation cracking is also attractive.

The counterblow hammer operates on the principle that all of the energy of two opposed rams is absorbed by the work. In many respects, the low speed counterblow hammer operates more like a forging press than a forge hammer.

Automatic handling has reached into many forms of cold heading operations where it has attained remarkable efficiency. For example, a new cold heading machine is able to produce up to 20 small nails per second. Progressive cold header operations are being performed today at rates 7 to 15 times greater than methods previously used.

Induction heating of forging blanks is increasing. In some installations, the part is taken directly from the conveyor through a hopper or magazine, through the heating coils, past a temperature indicator and into an automatic forging machine; handling is completely automatic. An increasing number of induction installations that are partially automatic use hopper or magazine feeds. One recent installation uses 60 cycle induction heating to bring the billet to intermediate temperature. High-frequency current then raises the part quickly to forging temperature.



4 Henry & Wright Div.

Improved die steels last longer

Induction heating is also being used to heat the ends of bars as they pass through a coil in a forging machine. The bar is heated, cut off and forged in a series of operations without reheating or manual handling. A high production hot nutmaking machine works on this principle.

Use of salt baths and of so-called fast-heating gas burners in forge heating furnaces is gaining wider acceptance.

Forging die costs have been the subject of much experimentation. Use of highly alloyed die steels has had some success although the benefits have been generally confined to small dies. Here, die life has been extended as much as 25 pct. Similar success has not been reported for larger press forging dies. Increased use of scale-free forge blanks has been an important factor in reduced die costs.

Die typing offers a promising approach to the subject of reduced die costs. The use of electrolytic machining for die forming is also being seriously considered.



5 Aluminum Co. of America

4 HEAVY DUTY automatic transmission parts are formed in one operation on this big dieing machine which takes off-center die loads easily.

5 ALUMINUM FORGING press, designed and built by United Engineering and Foundry Co., has 8000 ton forging pressure, stands 38 ft above floor.

6 WORKHORSE in most plants where sheetmetal and plate are handled is the power squaring shear.

6 Niagara Machine & Tool Works



Growing experience with impact forging has proved this method suitable for a variety of parts difficult to fabricate by other methods. While it has been applied more widely for nonferrous parts, it has a definite future in production of steel parts. Impact forging, applied to aluminum, offers economies in machine and labor times, produces parts with mechanical properties similar to regular die forgings. Grain direction is refined and strength usually improved. The method is especially useful where small orders of complicated, unsymmetrical shapes make regular machining methods costly.

Modify hot extrusion process

The hot extrusion process using glass as a lubricant has been modified extensively since it was first introduced into this country from France several years ago. A number of new products are being made successfully by this method. Among the materials in addition to conventional steels that can now be hot extruded are titanium, nodular iron, 19-9 alloy, and 16-25-6 alloy. Many of these alloys resist hot piercing and, therefore, could not be made readily in tubular form.

Another promising field for hot extrusion is special shapes, including circular shapes, in which the inside and the outside shapes are not similar. Ability to produce such forms in volume has, heretofore, often been restricted by cost considerations.

Cold extrusion of steel is just beginning to come of age. In the past few years, great strides have been made in the application of the cold extrusion process to production of steel parts. It is now possible to produce cold extruded steel parts from low carbon steels, including 1010 and 1012.

The U. S. Air Force heavy press program is progressing but experience with these big presses is limited. These machines are of two kinds, forging presses and extrusion presses. The former range in size to 50,000 tons while the extrusion presses range from 8000 to 12,000 tons. One German extrusion press is rated at 14,000 tons.

These presses will be used to squeeze out or forge in one piece large airplane sections now made by assembling a number of smaller parts. Forging or extrusion of the larger, one piece parts will allow greater freedom to designers, give greater strength with less weight. Initially the presses will be used to form light metals, primarily aluminum and magnesium, and eventually perhaps titanium.

While application of the heavy presses will of necessity be limited, industry as a whole is expected to receive much benefit from the increased knowledge of pressworking operations and of press and die construction. Greater pressures and larger working areas will be available.

From the applications of these presses will come new concepts of how metals may be worked. New methods of pressworking could well result.

Flexible presses specifically designed for compacting metal powders have opened the way to economical production of an increasingly wider variety of metal powder parts. Larger, more complex metal powder parts, to exacting specifications, can be produced with modern presses. Pressures as high as 75 tons per square inch are used in compacting many powder metal parts. Use of multiple motion presses has simplified tooling requirements and lowered tooling costs. Presses have been designed with closer, more accurate controls to speed setup and reduce press downtime.

Many advantages can be attributed to the use of automatic handling in the pressroom: (1) Increased production; (2) improved quality; (3) reduced in-process inventories; (4) better working conditions; (5) higher output per square foot of floor space; and (6) lower unit cost.

Modern press shops have a number of new devices available to them, including dial feeds, automatic feeders and ejectors, transfer presses, progressive die presses and a variety of automatic turnovers, catapults and similar devices.

Many presses have hopper feeds. Others have self-ejecting piercing dies or similar types of automatic equipment. Unnecessary manual handling of blanks or finished parts is eliminated wherever possible. In a plant so equipped, efficiency is high.



7 Volkert Stampings, Inc.

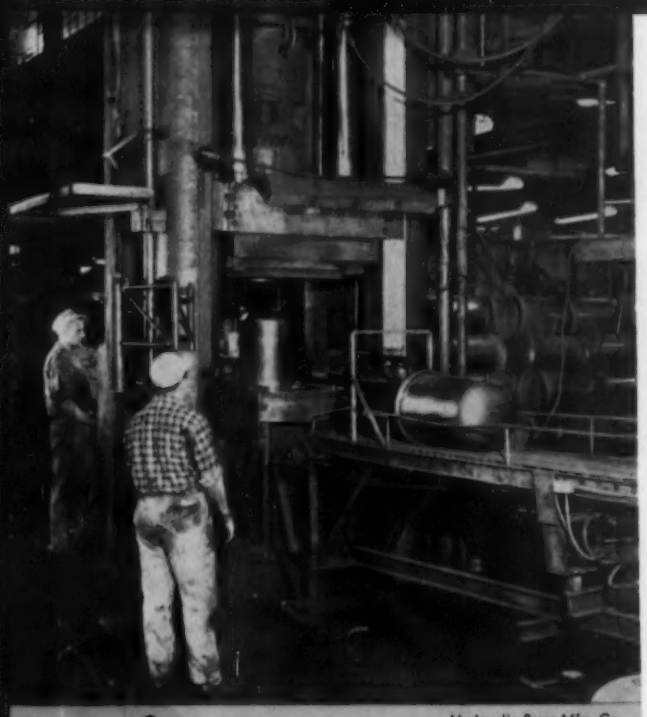
Presses built to JIC standards

The need for greater interchangeability of dies between presses and the equally compelling requirement of simplifying die design has led to a need for standardization of major press dimensions, including front-to-back, right to left, shut height and other details.

This entirely voluntary effort at standardization of the working area of presses was begun by an automotive group back in 1946. Working together, press users and press builders have evolved a group of press standards known as JIC or Joint Industry Conference standards. Presses built to JIC standards, while they are not yet always considered as standard designs, are being ordered by an increasing number of press users, including automotive, agricultural implement and other volume stamping producers.

The following classes of presses are now covered by JIC standards:

1. Open-back, inclinable presses.
2. Straight side, singe action, single point presses.
3. Straight side, single action, multiple point presses.
4. Rail or frame presses.



8 Hydraulic Press Mfg. Co.

5. Double action, single and multiple point presses.
6. Triple action, multiple point presses.

Standardization of the stroke, die space, bed and slide areas has greatly facilitated the interchangeability of dies in the big press plants, regardless of the builder.

There are also numerous advantages for the smaller press shop. Press shop maintenance problems have been simplified by specifying construction details of such things as bolster plates, machined surface, bolts, position of T-slots, slides and beds for the various types of presses.

Standards for presses have also been voluntarily agreed upon covering hydraulic and electrical equipment by press users and press manufacturers. This step has been taken to facilitate maintenance, and shorten downtime in the event of a press breakdown. Mutual agreement on these details of construction has worked out in many instances to the advantage of both the user and the press builder. Application of the standardized presses will simplify press operations in many user plants.

Efficient application of automation in the press shop often requires a new concept of part design which keeps in mind both the possibilities and the needs of automatic handling. Design thinking must, to achieve maximum benefits, be carried beyond the manufacturing stage into automatic assembly. While the concept of press assembly is not new, its application on a wide scale is new. The application of press assembly methods tackles one of industry's larger manufacturing costs. The possibilities for lowering costs through the application of automatic assembly operations have scarcely been scratched, many manufacturing experts believe.

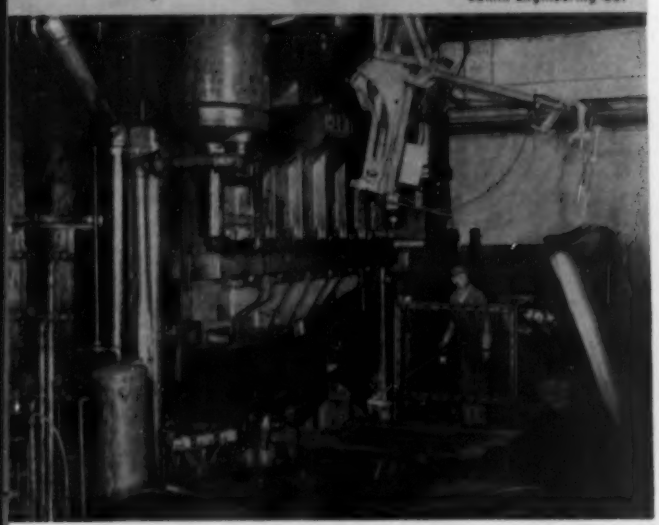
7 SIXTEEN STATION progressive die turns out 55 completely formed electronic tube bases per minute, replaces a multi-press operation.

8 FAST ACTING hydraulic presses have made easy work of difficult, deep-drawn metal parts.

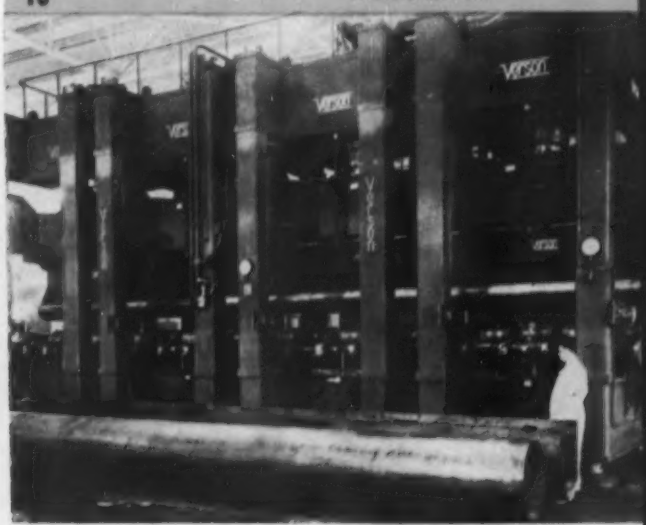
9 LARGE DRAWN metal parts are easily handled in and out of presses with modern handling devices.

10 FORTY FOOT lengths of steel pipe are U-formed on this big press used in line pipe production.

9 Sahlin Engineering Co.



10 National Tube Div.



PRESSWORK

the future

APPLICATION of automatic handling to press operations and solution of many problems in automatic processing, have compelled a re-evaluation of pressworking and presses. Trends evident in today's operations form the basis for the more highly productive press operations of the future. Press speeds will be higher; cycles will permit more complete utilization of equipment working time. More diversified production will be possible on presses of the future.

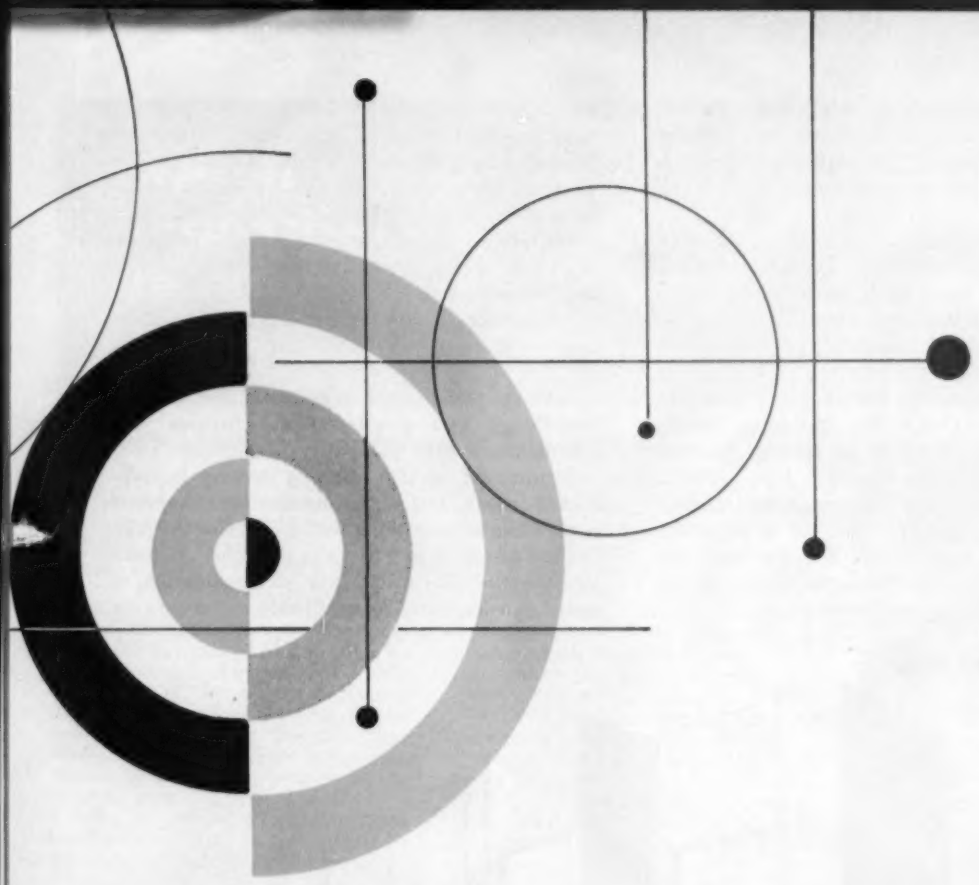
Despite spectacular gains in recent years, it seems likely that press speeds will reach new highs in the future. A few progressive dies already operate at speeds above 600 pieces per minute. For a few applications the upper limit may exceed 1000 pieces per minute 10 years hence.

Use of light, strong metals to permit faster movement of slides has been suggested. Reduced friction in both revolving and sliding members has contributed to the higher press speeds now possible. Highly integrated lubrication systems—motor drives shut off automatically if all bearings are not receiving lubrication—will continue to aid in development of faster presses.

Looking beyond the speed limitations of presses, press shop managers are seeking a greater number of press strokes per minute. Typical is the upside down draw technique which substantially increases permissible strokes per minute.

Purchasing, engineering, production and methods will be more tightly integrated than ever. Design engineers are giving more thought to manufacturing problems. The reason is economic. An automobile producer reports that at least half of all the pressed metal parts on a new model were revised to some extent to facilitate press operations before the new car went into production.

A technique that may be used more often is use of reverse bending. It has been found more advantageous in some cases to form a part in such a way that the next operation practically reverses the form previously given the metal. The method is not unlike making a pocket and then turning the pocket inside out.



Progressive dies, used for large volume production of shallow drawn parts, are increasing in popularity. Strip as wide as 40 in. is being drawn in a series of operations in which the part remains tied to the strip until the final operation. A recent modification, typical of future trends, permits cutting the part free of the strip under certain limited circumstances. Wider presses to accommodate progressive die setups will become common.

Major automotive stampings like hoods, roofs and doors are not now being made in progressive dies. However, many far sighted process engineers feel that, with expected improvements in presses, such production may be possible in the future.

Transfer press applications are growing steadily in the auto industry. Operating on the progressive die principle, the transfer press works from blanks instead of strip. Partially formed blanks are ejected automatically from the die after each stroke and carried forward to the next station. A single stroke press is used. Dies are usually built as separate units and many use scrap cutters and other unusual features. First cost is high, but savings in metal and elimination of unnecessary handling have made transfer presses economical for many high volume operations involving deep draws.

An interesting press now undergoing tests uses the flying shear principle. Slide and bolster both move. Steel sheet is fed continuously. Movement of punch and die follows an elliptical pattern. Reports indicate that forming, trimming and piercing operations can be performed at production rates far above the rates possible today. While still experimental, the new press is receiving serious consideration by pressworking engineers in Detroit.

Reduced scrap and scale have resulted from rapid heating of forging blanks. Radiant gas and induction heating have both been used successfully. Either can be integrated into automatic handling. Ability to heat only localized areas are additional advantages. Extension of both heating methods by the mass production industries is expected.

New and bolder attempts at the use of die typing will be made in an effort to reduce die costs. Experimental work with electrolytic machining will continue on an even larger scale.

Forging production of the future will be highly automated. One development which should grow is the automatic impact forging operation. A forging blank, held in mid-air, is struck simultaneously from opposite directions. Machines of this type—vibration-free and lacking the usual crash of the forging hammer—operate at high speeds and can be readily integrated with many automated forging setups.

Extension of salt bath heating in forging

should not be overlooked. Also, heating forging billets in a controlled atmosphere furnace has improved forging quality and cut costs. Emphasis will be on fast, controlled blank heating.

Shot blast cleaning in the forging industry is certain to be extended. Stream pollution regulations will often be a factor in decisions about cleaning in the forge plant.

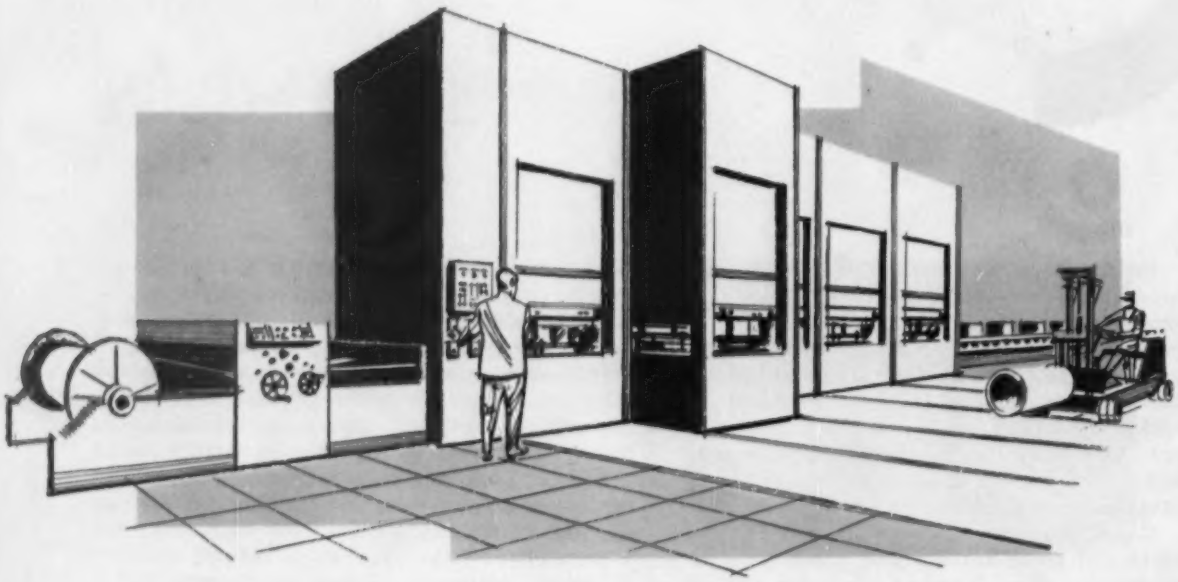
Wider use of fast preforming rolls which permit simplified secondary forging press operations is expected. Better grain flow and a superior product at lower cost often result.

While the auto industry is feeling its way rather carefully with plastic dies, plastic checking and assembly fixtures have already gained wide acceptance. Ease of duplication, accuracy, light weight and a favorable cost setup will undoubtedly result in a fast growing list of automotive applications.

which may be produced on extrusion type dies has been limited as to shape and contour, the process offers advantages which make its use worthwhile. Look for future extension of the method as engineers and designers become acquainted with the process. Cold extrusion of alloy steels, titanium and other metals may be expected.

Production of powder metal parts, involving one or more press operations, now holds a position of top importance as a press working operation. The rapid development of powder metallurgy and powder metal presses has established a sure place for this process.

Attainment of close to full density in compacted parts and the combination in metal parts of unusual mechanical properties through the use of metal powders are possible. Growth in both the size and range of application of metal powder parts is inevitable.



Use of hardened steel inserts in plastic tooling is interesting. Up to now, there have been both failures and successes in attempts to use this approach.

Stretch forming, rubber pad forming, fluid forming and impregnated wood forming have continued to grow. While application of these processes has been limited to low volumes, they show a strong growth potential.

Impact extrusion of both ferrous and nonferrous parts may be expected to increase. Parts of difficult contour can be formed cold successfully and rapidly from aluminum. Development of improved die materials and growing acquaintance with extrusion methods assure the process a place in the future.

Cold extrusion of steel is expected to take its place as an important industrial press fabricating method. While the range of forms

PRESSES OF THE FUTURE, designed to produce a variety of parts at one time from full coil widths, will offer pressures, productivity and flexibility far beyond those available to industry today. From the great presses of the aircraft industry will come a new understanding of the behavior of metals, especially the light metals, under great pressures. From the improved productiveness of modern presses will come fresh concepts of the tasks presses can accomplish. New highs in press speeds, with upper limits exceeding 1000 pieces per minute in some instances, may be widely available to industry of the future.

(Advertisement)

RHOADS industrial leather news

oldest industrial firm in U.S.A. welcomes *Iron Age* to the "100 year club"

253 years in the manufacture of fine leather

J. E. Rhoads & Sons joins with a host of newer organizations extending their best wishes to Iron Age on its 100th Anniversary.

J. E. Rhoads & Sons is a business concern that is unique in American industry. It is a business whose progress can be traced through the pages of American history. And in turn, its history records the growth and development of the American leather industry. It is unique, for its age, of course . . . and, for the fact that throughout its 253 years it has continued to devote its efforts to the tanning and working of leather.

Like so many other American business concerns, it too, began as a handicraft industry . . . expanding into a manufacturing organization as a result of the Industrial Revolution. It too, devoted much to the research and development of its products to keep abreast of the demands of modern industry. Although today it is not a giant on the American industrial scene, it is performing a job for which it is well fitted . . . the production and distribution of high quality industrial leather products.

For still better service to their customers, Rhoads has just moved its Philadelphia headquarters to their plant location at 2100 W. Eleventh Street, Wilmington 99, Delaware, thus coordinating research, production and sales all under one roof.





lowest belt cost per ton of steel ever produced by Atlantic Steel

PROBLEM: To lower leather belt costs on a drive operating a 5 roll stand intermediate rod and Merchant Bar Mill and consequently to obtain lower manufacturing costs per ton of steel produced.

SOLUTION: After trying several makes of flat leather belting, Atlantic Steel Company, Atlanta, Georgia installed 81-10/12′ + Lap X 48″ heavy 3 ply Tannate Watershed leather belting. This belt was specially tanned choice center stock leather developed by J. E. Rhoads and Sons, and as a result was able to withstand terrific heat and moisture plus exceptionally heavy starting and shock loads. Belt speed varies from 2600′ per min. with the product rolled. After running almost continuously for 2½ years during which time the mill rolled 218,515 tons of steel, the belt was taken off, cut up into narrow belts and used in various departments around the plant.

Besides stating that Rhoads Tannate Belts have out-produced all other previous makes on this drive, Atlantic Steel officials calculated the belt cost per ton of steel produced at .0209 cents per ton, the lowest belt cost ever attained by them.

new type heat-resistant packings for hydraulic & pneumatic equipment

Rhoads has recently developed a new heat-resistant leather for hydraulic and pneumatic applications.

During the last several months these packings have been under intensive field tests and, as a result, they have been very well received by Industry.

Tannate heat-resistant packings are recommended for temperatures up to 190° F. continual use or for sporadic use up to 210°F.

Tannate Packings will not readily cold flow or score the most highly finished surface. They provide an effective seal against hydraulic oils and many other gasses and liquids.

Tannate has a low coefficient of friction . . . is custom impregnated for high or low pressure operation—precision molded and accurately finished to fit snugly against shafts and cylinder walls.

For further information, send for the Rhoads Packing Data File. There is no obligation.



Robotron CAN PROTECT YOUR PRESS DIES FROM BREAKAGE

. . . through the use of

ELECTRONIC DIE SAVER PRESS CONTROL



Robotron CAN

SAVE THOUSANDS ON PRESS OPERATIONS!



Robotron ELECTRONIC DIE SAVER CONTROL

● Electronically operated, this revolutionary press stamping control guards against the possibility of smashing expensive dies, holds press "down time" to a minimum.

Faster automatic press feeds are possible when this electronic "watch dog" is on guard . . . production is increased . . . operating costs reduced.

Learn the full story of this newest development in press stamping "Die Saver Controls."

See how it can mean the savings of thousands of dollars in your press operations!

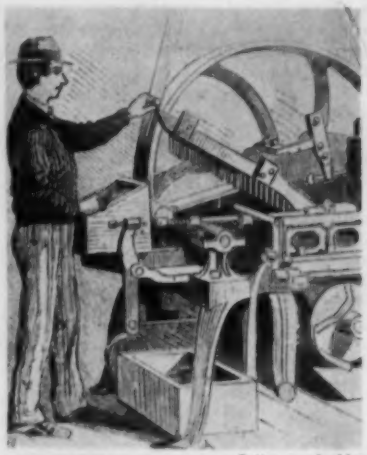
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Robotron CORPORATION | 21300 WEST EIGHT MILE ROAD DETROIT 19 MICHIGAN

Quotes: 1855 — 1955

Abstracts from past issues of THE IRON AGE, *selected for their flavor, and with some regard for whimsy:*



Bettmann Archive

SWAGING MACHINE in a nut and bolt factory, shows early chute feed.

The Anvils Ring

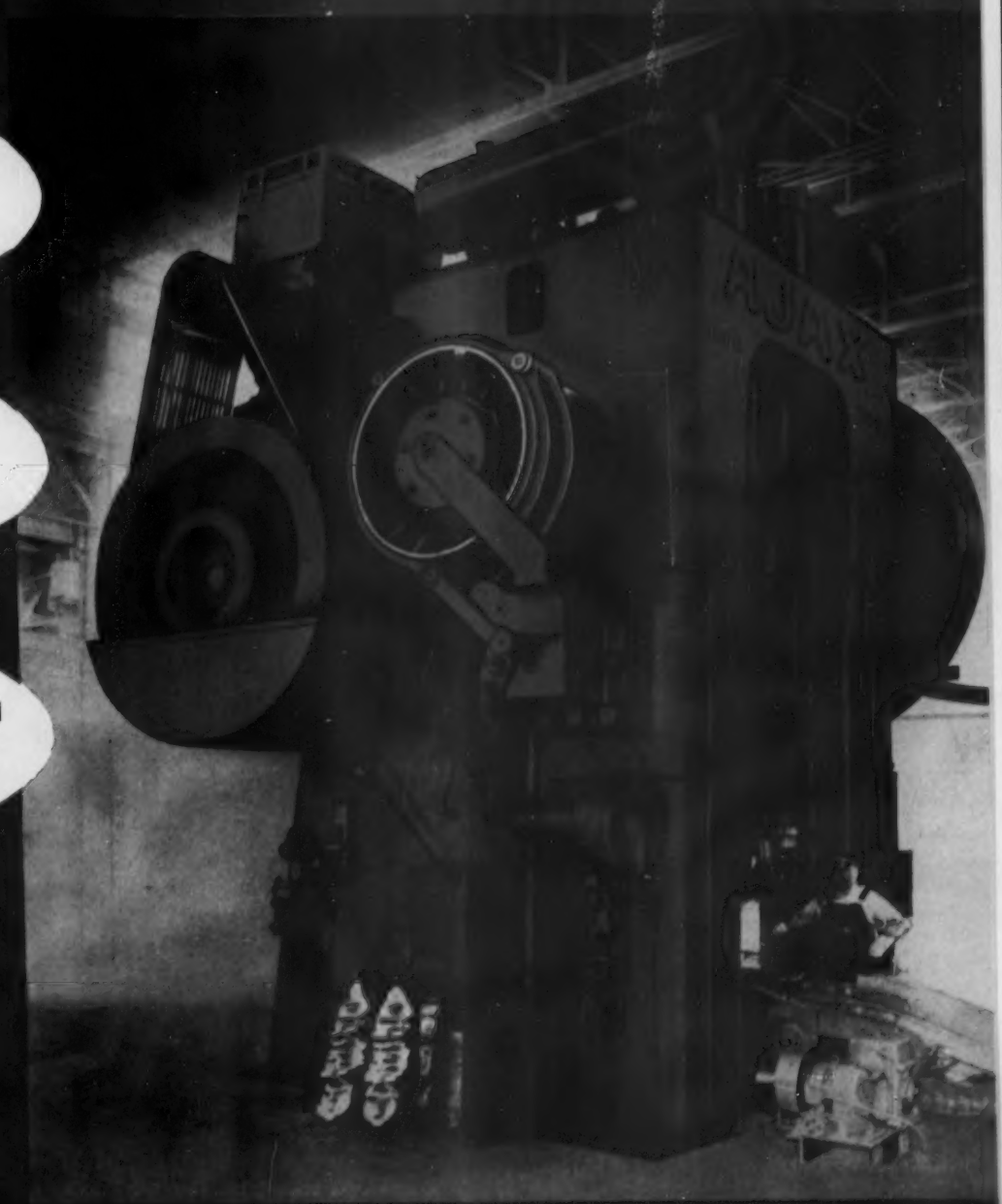
Clang, clang! the massive anvils ring;
Clang, clang! a hundred hammers swing—
Like the thunder-rattle of a tropic sky,
The mighty blows still multiply—
Clang, clang!
Say, brothers of the dusky brow,
What are your strong arms forging now?

Clang, clang!—again, my mates, what glows
Beneath the hammer's potent blows?
Clink, Clank!—we forge the giant chain,
Which bears the gallant vessel's strain
'Midst stormy winds and adverse tides;
Secured by this, the good ship braves

AJAX

high speed

FORGING PRESSES



SOLID STEEL FRAME

AIR CLUTCH OPERATED

SIZES 300 TON TO 8000 TON

Write for Bulletin 75-C

THE AJAX MANUFACTURING COMPANY

EUCLID BRANCH P. O. CLEVELAND 17, OHIO

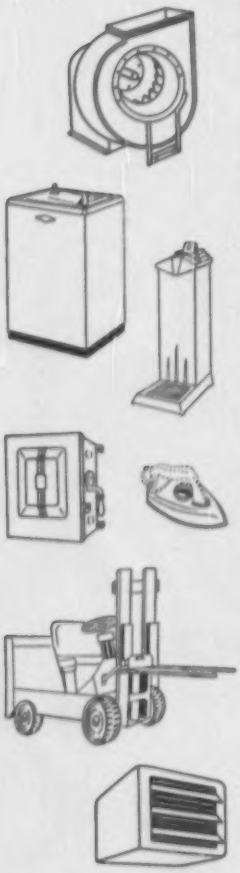
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W. P. WOOLDRIDGE CO.

1209 BURLINGAME AVE., BURLINGAME, CAL. • 6440 FLEET ST., LOS ANGELES 22, CAL.

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You *DO NOT ADD* capital investment or top-heavy production costs! Let us show you how Brandt can produce components and assemblies to your *profit* advantage!

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CHARLES T. BRANDT, INC.
1700 Ridgely Street, Baltimore 30, Md.

Formings . . . Stampings . . . Weldments

QUOTES: 1855—1955

The rocky roadstead, and the waves
Which thunder on her sides.

Hurrah!—cling, clang!—once more, what glows,
Dark brothers of the forge, beneath
The iron tempest of your blows,
The furnace's red beneath?

Cling, clang!—a burning torrent, clear
And brilliant of bright sparks, is poured
Around, and up in the dusty air,
As our hammers forge the Sword.

The sword!—a name of dread, yet when
Upon the freeman's thigh 'tis bound—
While for his altar and his hearth,
While for the land that gave him birth,
The war-drum's roll, the trumpet's sound—
How sacred is it then!

August, 1859



Bettman Archive

STAMPING PRESS used in the manufacture of steel pens about 1880.

Would Make Copper Wire

The rapid growth in the demand for copper wire has induced a number of iron wire mills to seriously consider the question whether it would be advisable to put a part of their plant into shape to make copper wire. As yet, however, no definite decision has been reached.

Mar. 12, 1885

convert COIL STOCK



to "custom cut" flat blanks



in ONE operation on this LITTELL line-up



20-ton coil is supported and uncoiled from this No. S400-72 Littell Power Driven Automatic Centering Reel.

flattened stock, accurately measured — 10" to 180" is fed from this No. 7-76 Littell Hydraulic Driven Feeding and Straightening Machine.

custom cut blanks are removed by magnetic rolls from the shear mounted on the Littell Oscillating Shear Base. By swivelling the Shear as much as 25° either direction from center between each feed stroke, the base permits cutting to the angle desired.

All three units independently motor driven and electronically synchronized

This Littell trapezoid sheeting line brings three vital advantages. It permits "custom cutting" of flat blanks. By nesting, it produces trapezoids, keystones, rectangles, triangles and parallelograms in required sizes with no waste whatsoever. Its completely automatic operation saves time and labor.

The S400-72 Reel and the No. 7-76 Straightener in this combination are widely known through years of successful press room service. The Hydraulically operated Shear Base is new. It mounts a conventional shear. The Base can be set to hold the shear in stationary position for cutting rectangles and parallelograms or to oscillate the shear after each feed stroke to produce angular cuts for special shaped blanks. The cutting angle can be shifted as much as 25° to each side of center. Like its companion machines in this set-up, this special Oscillating Shear Unit will deliver the outstanding, low cost performance which industry has expected of Littell equipment since 1918.

Write for Photo-Bulletin No. 1368

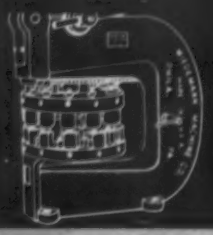
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WIEDEMANN *combines in ONE machine*

1. the speed of a punch press
2. turrets carrying 12 to 32 punches and dies
3. a quick-setting, mechanical work positioning gauge

WIEDEMANN *Cuts Piercing Costs 60% to 90%*

- **ELIMINATES SETUP** — Necessary punches and dies are carried in turrets . . . any tool is rotated to piercing position in 3 to 5 seconds.
- **ELIMINATES LAYOUT** — Material to be punched is rapidly and accurately positioned with a Wiedemann work locating gauge.
- **UNLIMITED FLEXIBILITY** — Punches and dies of any shape and size can be used within the capacity of the press. A variety of openings can be made with the same punch and die.

Send drawings of your work for both time studies and recommendations on the Wiedemann Turret Punch Press and tools best suited for your needs. Every Wiedemann press is shipped completely tooled, ready to produce when leveled and connected to a power line.



R-44

. . . chassis, panels, and other flat metal components quickly positioned with a gauge or pierced through conventional templates.

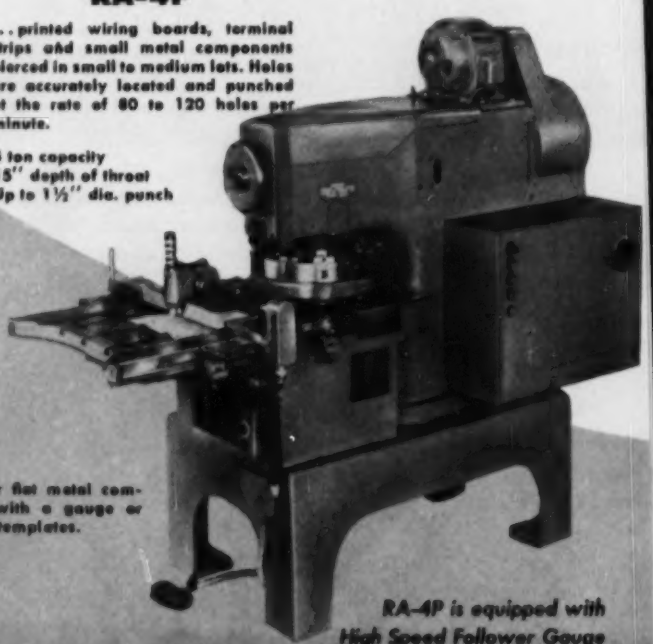
15 ton capacity
28" depth of throat
Up to 3½" dia. punch

R-44 is shown with Rack Type Gauge

RA-4P

. . . printed wiring boards, terminal strips and small metal components pierced in small to medium lots. Holes are accurately located and punched at the rate of 80 to 120 holes per minute.

4 ton capacity
15" depth of throat
Up to 1½" dia. punch



RA-4P is equipped with High Speed Follower Gauge

W I E D E M A N N

IS THE ULTIMATE
PIERCING ECONOMY

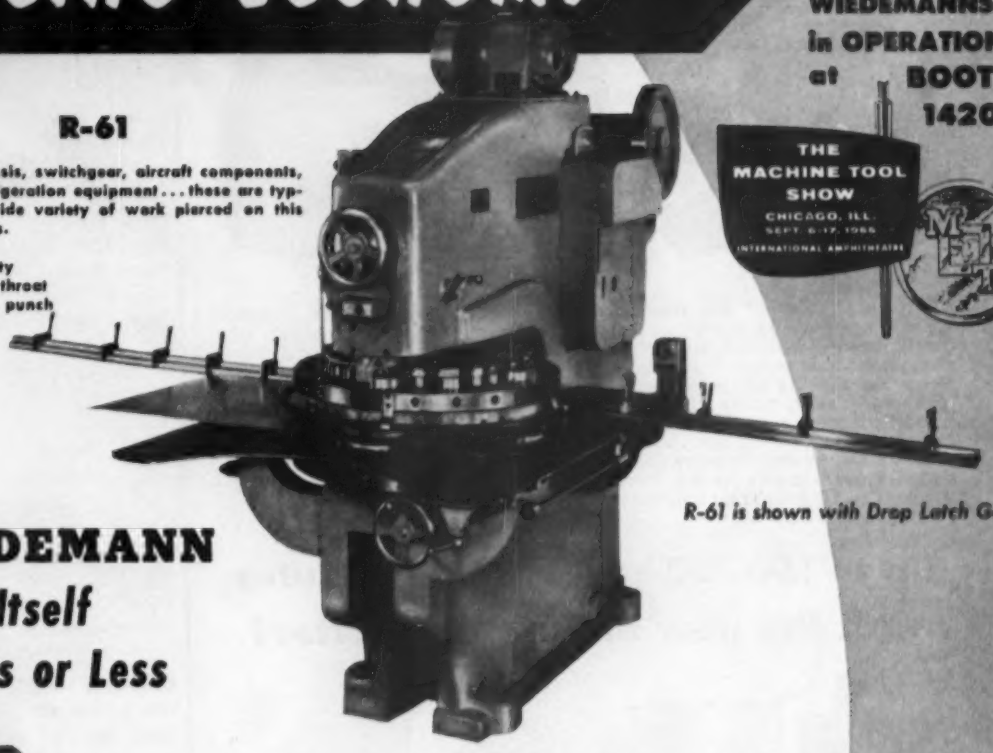
SEE 8 WIEDEMANNS in OPERATION at BOOTH 1420

THE MACHINE TOOL SHOW
CHICAGO, ILL.
SEPT. 6-17, 1955
INTERNATIONAL AMPHITHEATRE

R-61

...radar chassis, switchgear, aircraft components, industrial refrigeration equipment... these are typical of the wide variety of work pierced on this versatile press.

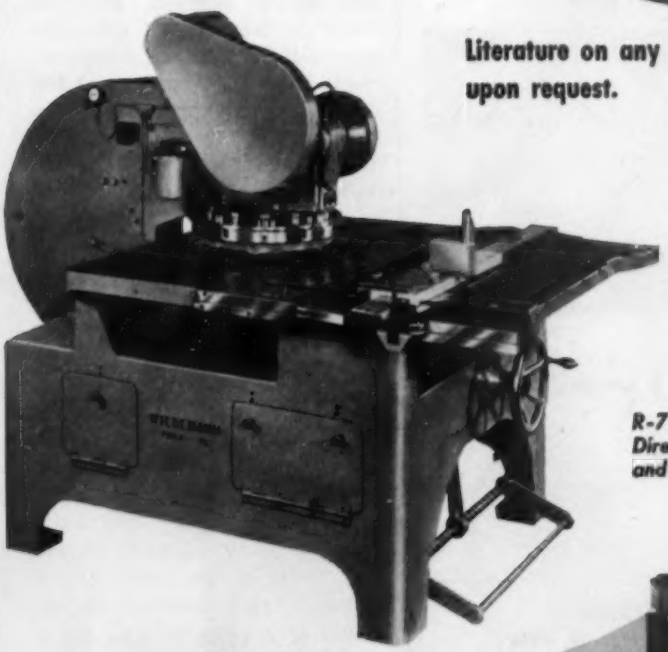
40 ton capacity
33" depth of throat
Up to 6" dia. punch



R-61 is shown with Drop Latch Gauge

A WIEDEMANN *Pays for Itself in 2 Years or Less*

Literature on any of these Wiedemann Presses will be sent upon request.



RA-41P

...high speed piercing of electronic chassis, panels, components and similar work.

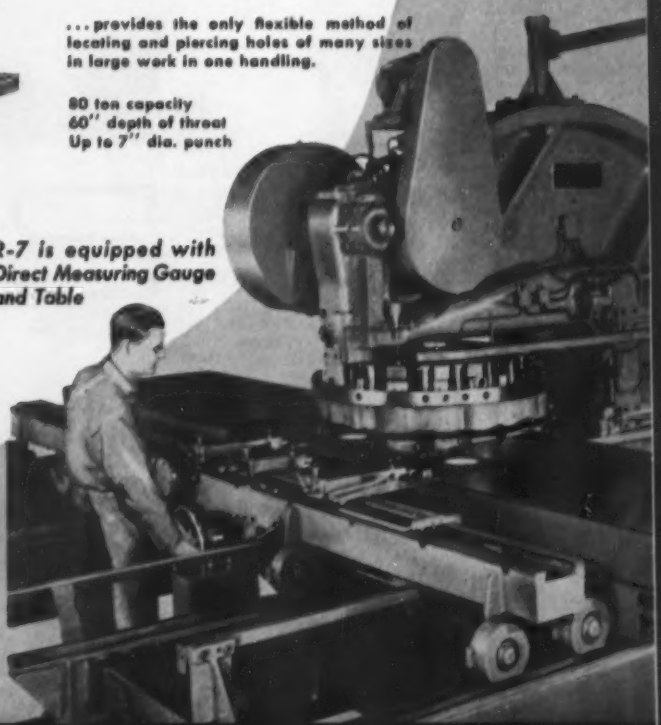
15 ton capacity
28" depth of throat
Up to 3½" dia. punch

RA-41P is equipped with High Speed Follower Gauge

R-7

...provides the only flexible method of locating and piercing holes of many sizes in large work in one handling.

80 ton capacity
60" depth of throat
Up to 7" dia. punch



R-7 is equipped with Direct Measuring Gauge and Table

MACHINE CO.

4272 WISSAHICKON AVENUE
PHILADELPHIA 32, PA.

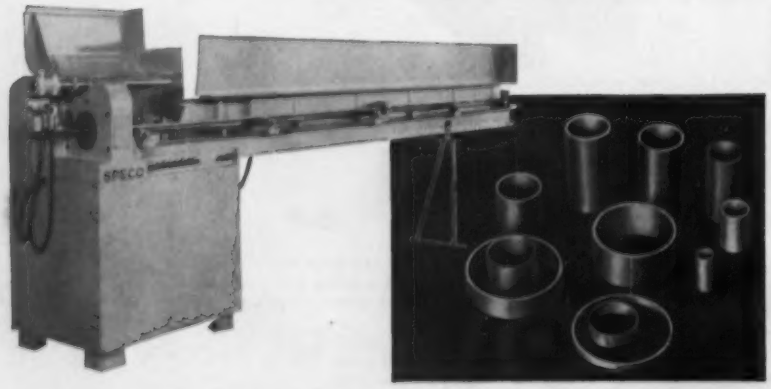
You can trim drawn shells like these in a single press stroke!



The Brehm "Shimmy" Die employs a *radically new* trimming principle . . . completely different from ordinary trimming methods. *A cam action inside the die moves the shearing edges four ways*—eliminating slow, costly "horn" and "pinch" trimming operations. You get a perfect edge finish every time . . . and a single die may be used for many different shapes. Production goes up fast. Production costs are slashed! Trims stainless and mild steel, copper, brass, zinc, aluminum, gold, silver, fiber, rubber, plastics. Trims all sizes from fountain pen ferrules to refrigerator doors—in almost any thickness that can be drawn. Brehm Dies can be used in mechanical or hydraulic presses.

The NEW Brehm Trimming Press does *all* trimming in one press stroke . . . takes less power, trims shells up to 16 inches square, 6 inches deep, .125 inch stock—metals, plastics or fibers.

Up to 10,000 pieces in 86 minutes with the new Brehm tube cutter!



The revolutionary Brehm Tube Cutter has a cutting action that makes it the finest machine of its kind ever built! Cuts tubes 3/16" to 2¼" O.D.—with production speeds ranging up to almost 7,000 pieces per hour! With the Brehm shearing action, *there is no loss of stock*—no burred tube ends! Up to 25% more pieces from the same length of stock. Cuts almost any tubing—mild steel, stainless steel, brass, copper, aluminum, etc.

Brehm

DIVISION OF SPECO

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- ☐ BREHM TRIMMING PRESS
- ☐ BREHM TUBE CUTTER

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QUOTES: 1855—1955

Jersey City Gold

A local sensation has been created in Jersey City by the discovery of a gold mine while sinking a well. The workmen, after passing through a vein of iron ore, struck a quartz vein containing gold at a depth of 900 feet. Geologists suppose that this quartz belongs to the Appalachian range, running from Nova Scotia to the gulf and having outcroppings in Virginia, North Carolina and Georgia.

Nov. 2, 1876

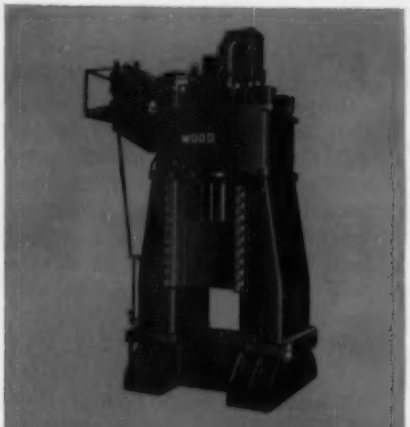
Ductile Iron

A new engineering material which combines the process advantages of cast iron with the product advantages of cast steel is described by the authors. Closing the gap between cast iron and cast steel, this material is characterized by a graphite structure wholly in the form of spheroids. Its excellent physical properties, particularly high elastic modulus, high yield strength and high ductility, suggest its suitability for many applications heretofore considered beyond the scope of cast iron.

Feb. 17, 1949

Huge Silver Brick Found at New Orleans

Much interest was excited on the 19th ult. by the unloading at the New Orleans Exposition of the famous Mexican brick, which arrived early in the morning, via Galveston, and occupied the attention of a gang of men for a good share of the day in getting it from the car into the main building, where it was left for the night. The brick is made of solid silver, mined in the State of Chihuahua. It is 6 feet long, 6 inches thick and 3½ feet wide. It bears on top a peaked model of two



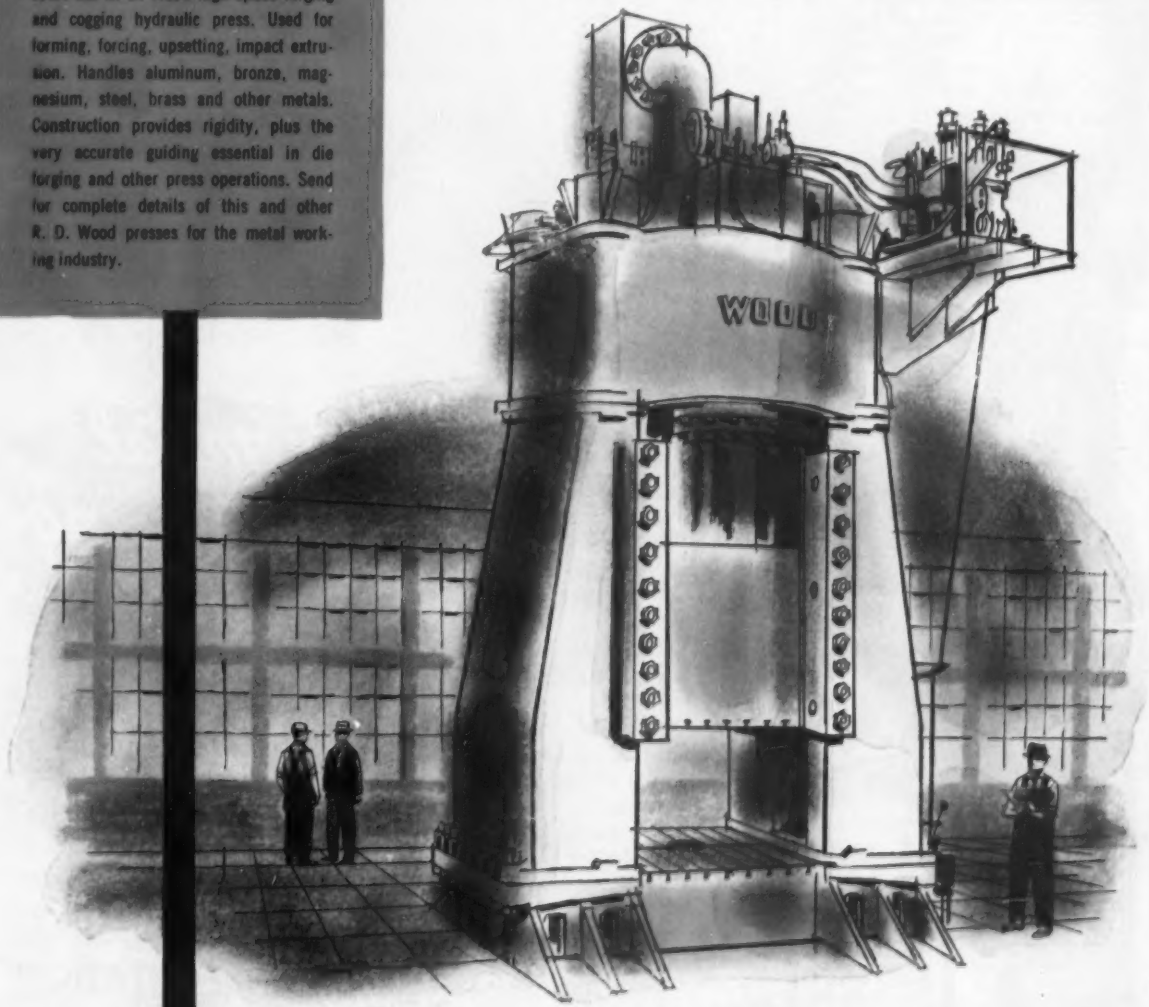
3,000-ton R. D. Wood high speed forging and cogging hydraulic press. Used for forming, forcing, upsetting, impact extrusion. Handles aluminum, bronze, magnesium, steel, brass and other metals. Construction provides rigidity, plus the very accurate guiding essential in die forging and other press operations. Send for complete details of this and other R. D. Wood presses for the metal working industry.

150 years of excellence

This is not an empty claim. It's a fact and a challenge.

In more than 150 years of service to industry, R. D. Wood's name has never appeared on a press of inferior quality.

You can *see* the proof of R. D. Wood quality in the precise design, select materials, and sound craftsmanship that distinguish our presses. And you can *see* the results of this quality in smooth, dependable performance, increased production, economical maintenance.



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Representatives in Principal Cities



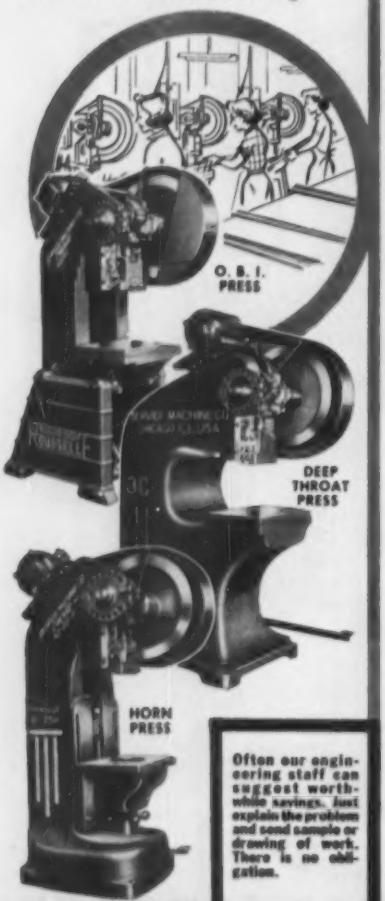
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You'll like the economical run-of-job cost, the simpler maintenance, the easier set up and operation and the wider variety of work each one can handle. And YOU'LL LIKE THE PRICE when you compare Rousselle specifications and quality . . . Ask for condensed catalog.



Often our engineering staff can suggest worthwhile savings. Just explain the problem and send sample or drawing of work. There is no obligation.

Rousselle presses are sold exclusively through leading machinery dealers.

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Mfrs. of Rousselle Presses
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mountains in Chihuahua, nearly 3 feet high. On each side is the inscription: "Mexico Etado de Chihuahua para la Exposicion de Nueva Orleans, 1884." There is nearly $200,000 worth of material in the mass, which, with the labor bestowed on it, makes its total value about $250,000.

Jan. 1, 1885



Bettmann Archive

BOLT FINISHING machinery as set up in a bolt making plant about 1881.

Photos Under Water

W. Thompson, of Weymouth, Eng., has a method of taking photographs at the bottom of the sea. The camera was placed in a box, with a plate-glass front, and a movable shutter to be drawn up when the camera was sunk to the depth of three fathoms. The camera being focussed in this box on land for objects in the foreground, was let down from a boat to the bottom of the sea, carrying with it the collodion plate, prepared in the ordinary way. The shutter of the box was raised, and the plate exposed for about ten minutes. The box was then drawn up, and the image developed in the usual manner.

June 18, 1856

Minerals In Kansas

Recent geological surveys show that the State of Kansas promises mineral resources which are to be extensive and important. Coal of good quality has been found to extend through twelve counties. Iron, lead and zinc are abundant, and the deposits of gypsum and manganese are comparatively inexhaustible. Copper is found in paying quantities, and marble, whet and limestone, rock crystal, mineral paints, kaolin, granite, freestone, various kinds of marl, grindstones, and slate are distributed throughout the State.

The Kellogg Lead Mines afford an insight into the mineral deposits of the State. These mines are located about ten miles northeast of Little Rock, and about six miles from the Cairo and Fulton Railroad. The mines are in a very deep valley, lower than the bed of the Arkansas River, where the lead crops out. These mines have only been operated at intervals and to a

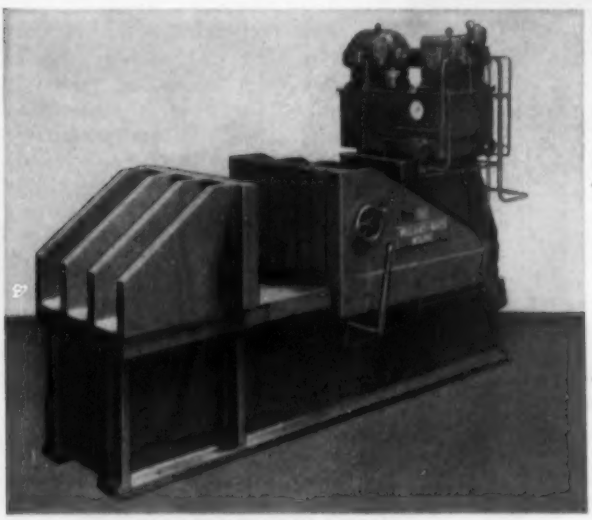
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INDUSTRIAL EQUIPMENT
FARM IMPLEMENTS
Lansing Stamping Co.
ESTABLISHED 1914
LANSING 2 MICHIGAN

WILLIAMS-WHITE
Horizontal Bender and Straightener

The versatility of the horizontal press is well represented by the 200 Ton Hydraulic Bender and Straightener illustrated, in the installation view at right. The 30" x 48" crosshead and end lug make this an excellent machine for straightening I-beams, channels and other sections.

The forward travel of the crosshead is adjustable by the handwheel mounted on the side of the crosshead. In the event the stroke is not sufficient to complete the desired bending or straightening operation, the operator merely turns the handwheel and the crosshead continues forward a distance proportionate to the movement of the wheel.





WILLIAMS-WHITE & COMPANY machinery is custom built to your specifications! Our designers and engineers are at your service, without obligation, to help you select capacity and type of machine most suited for your requirements. For more information consult your WILLIAMS-WHITE & CO. representative or write us direct.

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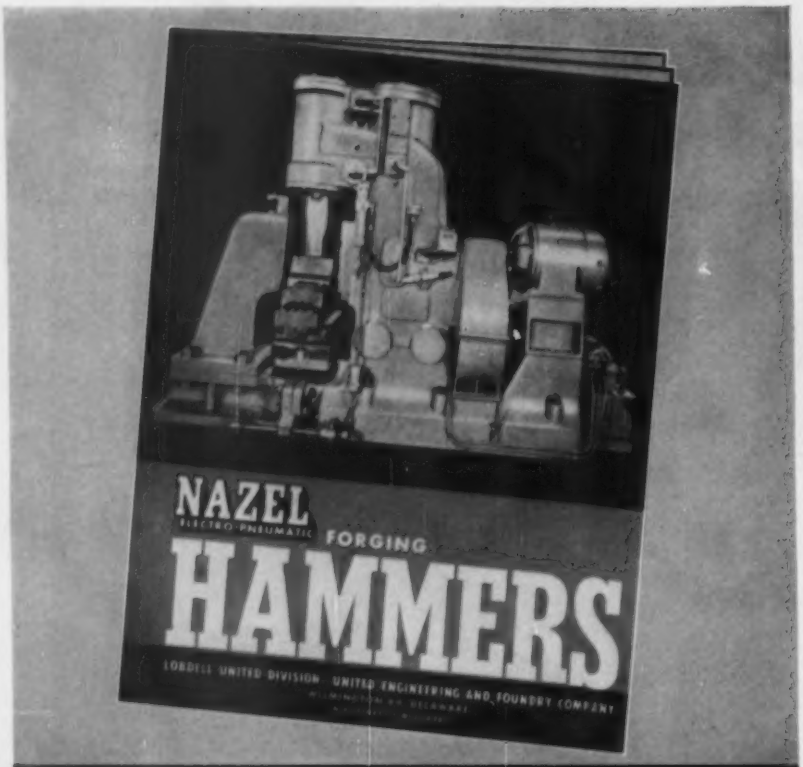
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For every requirement, the various types and models of NAZEL Hammers are on display in this new Hammer Catalog . . . along with specifications and examples of specific installations and applications.

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UNITED ENGINEERING AND FOUNDRY COMPANY
1836 WILMINGTON 99, DELAWARE 1955

very small extent, but recently have passed into the hands of a wealthy company, who in the spring will commence active operations. The deposit is found in parallel fissure veins, that crop out at intervals of a distance of about three miles. These have been penetrated only about forty feet, with increasing deposits. About 350 tons of galena have been taken out.

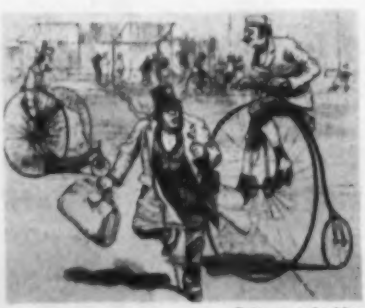
This galena never yields less than $40 to the ton of lead, and has yielded as high as $400. Copper in small quantities is found, often containing as high as 24 ounces of silver and two and a half of gold to the ton, while the argentiferous copper has yielded as high as from $1000 to $4000 to the ton.

Apr. 10, 1873

Predicts Bubble's End

As underpinning to the bull market in securities we have the interest rate for money relatively low and the yield of many good stocks and sound bonds relatively high. Consequently, investors do better by buying stocks and bonds than by lending their money for interest, and they can do even better by borrowing some money from those whose business it is to lend. Sooner or later these conditions will come into equilibrium and then the bull market will come to an end.

July 9, 1925



Bettmann Archive

POPULARITY of the bicycle wheeled traffic problems into daily life.

Missouri Lead Output

Lead, next to iron, occupies the most important place in the mineral products of Missouri. The lead mines are now only partially developed, but they cover a vast area of territory, and will in time prove a source of great prosperity to the State. Foreign pig lead was for many years imported into St. Louis, but the quantity gradually decreased, falling in 1869 to 7857 pigs, and to nothing in 1872. During the past year the receipts of lead at St. Louis amounted to 285,769 pigs, or 22,882,650 pounds, of which 20,427,000 were produced in Missouri. The exports of lead from St. Louis, in 1872, amounted to only 4,718,223 pounds, leaving 18,164,427 pounds retained for home consumption. The soft brands of Missouri lead are chiefly used for the manufacture of white lead.

— Feb. 13, 1873



Bettmann Archive

FORGE SHOPS such as this played an important part in America's growth. Board hammers are at plant of the E. D. Clapp Mfg. Co., Auburn, New York.

Large Order

The Winchester Repeating Arms Company, at New Haven, is said to have received an order from the Chinese government for 17,000,000 cartridges.

Mar. 11, 1880





BUSHINGS MUST MEET 3 RIGID NORTON SPECIFICATIONS

These Worcester Stamped Metal bushings are precision made to the following specifications, so that NORTON fast-cutting abrasive saws will seat properly on the arbor:

1. The drawn center hole in the stamping must be held to .002" tolerance in diameter.
2. The drawn center hole in the stamping must be concentric to the O.D.
3. The stamping must be absolutely flat, as the least tendency to "dish" will allow abrasive grains to work under the part and wear the arbor.

Just as thousands of these bushings are molded into NORTON cut-off wheels to satisfactory specifications for use all over the world . . . so are many other important Worcester Stamped Metal component parts produced to make a BIG difference in accurate end use.

Are you seeking a stamping source where you can depend on UNIFORM PRODUCTION?

Send samples and blueprints for quotations TODAY!

WORCESTER STAMPED METAL ©

WORCESTER STAMPED METAL Company

10 HUNT ST., WORCESTER, MASS., U. S. A.



SPECIALISTS IN SKILLED STAMPING SERVICE

Emphasis on Prevention Helps Cut Accidents

The experience of recent years at the Worcester (Mass.) works of the American Steel & Wire Co. has demonstrated that no matter how well organized and well conducted a system of accident prevention and of the handling of accident cases may be, persistent and stimulating effort will produce, year after year, further decrease in number of accidents and days lost to industry because of them.

Progess to Date

Previous to 1917, when the present system of classification of accidents was established, the Worcester works had accomplished tremendous things in reducing the menace of accidents. As in other plants of the same character the death and maiming of workmen used to be considered inevitable adjuncts of manufacturing. Philanthropy was exercised to relieve the distress resulting from accidents, but the idea of their prevention existed in most industrial establishments only in an untried or crude way.

Efforts Intensified

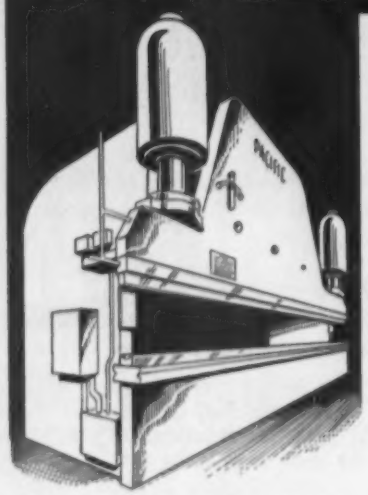
A quarter century ago, the movement toward reducing industrial hazard had its beginning, and the Worcester works, in common with all plants of the United States Steel Corporation, entered upon an era of intensive effort to make industry as safe as it could be in the face of carelessness, ignorance and recklessness. As a consequence, eight years ago so much had been accomplished that most observers believed success could not be carried much further.

Fewer Lost Days

The Worcester works, comprising the large north and south works and the smaller central works, and employing an average of about 5000 men, had 334 accidents in 1917, involving 7491 lost days. In 1924 there were 57 accidents, involving 4007 lost days. In the eight years the number of accidents dwindled 83 per cent, the number of lost days 47 per cent.

July 30, 1925

Versatility



Produces Profits

BENDING PUNCHING
BRAKING CORRUGATING
DRAWING BLANKING
ROLLING STRAIGHTENING

Anyone can operate it:
Can't be jammed or overloaded by inexperienced personnel.
Job can be set up quickly in any position along the bed.
Full tonnage is available at any point in the stroke.
Minimum wastage is obtained through accurate control.
Peak production is obtained by adjustment of stroke length.

World Wide Acclaim

Famous users in many parts of the world affirm that Pacific Press Brakes have proven satisfactory, profitable, and — above all — VERSATILE.



PACIFIC INDUSTRIAL
Manufacturing Company
848 FORTY-NINTH AVENUE OAKLAND, CALIFORNIA

Mexican Business

During the ten years which have elapsed since the overthrow of the ephemeral Mexican empire, our business relations with the neighboring republic have become more and more important, so much so that during the fiscal year ended with the 30th June, 1875, we exchanged with Mexico altogether $17,500,000 worth of goods.

Oct. 5, 1876

Installment Plan Sales Subject of New Bill

A bill was introduced on January 27 by Senator Thomas in the New York Legislature, of great importance to manufacturers and business men generally who sell on what is known as the installment plan. It proposes to exempt from the operation of the statute passed last year, and which went into effect September 1, 1884, known as the "Act requiring contracts for the conditional sale of personal property on credit to be filed in the town clerk's office," three articles hitherto covered by it, viz., furniture, sewing machines and pianos. This statute was intended to remedy certain evils connected with such sales. The manufacturer or dealer, for example, would sell such an article as a printing press or a sewing machine and deliver it to the purchaser. At the same time it would be agreed that the article should be paid for by installments, and that no title should pass until all the installments were paid. Quite frequently, also, the seller reserved the right to retake possession at once, or after a certain number of days, in case any installment should be due and remain unpaid. These contracts have been and are very common, and in the aggregate amount to many millions every year. This is especially true of sales of sewing machines, pianos and furniture, as the manufacturers of those articles sell very extensively to persons who are unable to pay for them immediately in cash, and the sales are, therefore, made on credit . . .

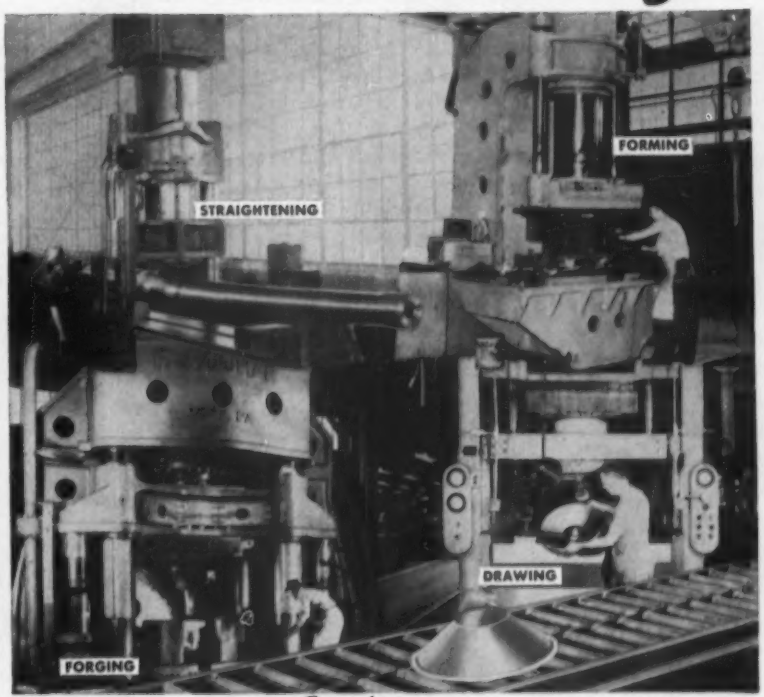
A Difficulty Arises

The difficulty arises just here. The purchaser, after receiving possession, but before the payment of all the installments, sometimes sells to a third person, who buys in good faith and has no knowledge of the other's contract, with its conditions. He is what the lawyers call a *bona fide* purchaser for a valuable consideration. He pays the full value of the article.

Farquhar

HYDRAULIC PRESSES

Eliminate Metal Cutting



Write for a copy of *Farquhar's* fact-packed Bulletin HP-49

CHIP MAKING IS COSTLY

Metal formed to size and shape eliminates long costly machining operations. These are typical examples of the broad range of *Farquhar* presses that form metal to shape and eliminate costly metal-cutting. They're fast, sturdy, and efficient . . . a wise investment for cost-conscious manufacturers. Farquhar's engineers will be glad to work with you on your metal-forming problems.

WRITE TODAY ⇒ for a copy of Bulletin HP-49 covering a broad range of Farquhar Hydraulic Presses.



THE OLIVER CORPORATION — Farquhar

A. B. FARQUHAR DIVISION

THE OLIVER CORPORATION, 1503 Duke St., York, Pa.

Who now has the better title or right to it, this honest buyer or the manufacturer—the original seller? Before the passage of the act of 1884 the Court of Appeals held that the original seller had the better right, and the last buyer must lose his money. This was on the ground that a man has a right to his own, wherever he finds it.

Feb. 5, 1885

Fractures and Fatigue

Methods of determining the static properties of a steel are readily available to the engineer and metallurgist, but the fatigue and impact values are not so easily or so quickly ascertained. There is a distinct need of the latter and it is becoming more insistent, particularly as automotive engineering expands. The rigorous service of the modern bus and truck makes unusual demands on the life of a steel.

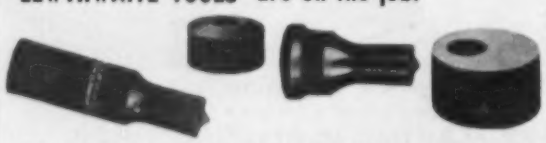
Declaring that the "most reliable fatigue machine is an overloaded Reo Speedwagon," the leader of an important discussion on needed improvements in automotive steels, in THE IRON AGE last week, suggests a new method of judging fatigue properties that promises to be of much value. From a study of the fractures of automobile parts which have failed in service over a considerable period, much light has been thrown on their fatigue and impact values. With this as a basis, the author his demonstrated by a series of investigations that there is a definite relation between the character of the fracture and the shock or fatigue life of the metal. . . .

Dec. 3, 1925

ACKNOWLEDGMENT

In addition to those mentioned in the text or in photo credits, the editors also want to thank the following for their help in preparing this section:
E. V. Crane, Chief, Special Engineering, E. W. Bliss Co., Copper & Brass Research Assn., Drop Forging Assn., National Machine Tool Builders Assn., Abdite Tool and Gage Co., Ajax Mfg. Co., Babcock & Wilcox Co., Baldwin-Lima-Hamilton Corp., Chambersburg Engineering Co., Chrysler Corp.: Dodge Div., Dodge Forge Div.; Denison Engineering Co., A. Finkl and Sons, Ford Motor Co., General Motors Corp.: Buick Motors Div., Fisher Body Div., GM Research, GM Technical Center, Pontiac Motor Div.; The Hydraulic Press Mfg. Co., The National Machinery Co., Ohio Crankshaft Co., Tocco Div., Olds Motor Works, Packard Motor Car Co., Parker Rust Proof Co., Ren-Ite Plastics, Inc., Rezolin Corp., The V & O Press Co., Worcester Pressed Steel Co.

Yesterday . . .
today . . . .
tomorrow . . . . .
any day metal is being punched, cut, or bent—
LEWTHWAITE TOOLS are on the job.



76 styles of PUNCHES and 65 styles of DIES to fit most makes of hand, foot, and power operated punch presses are now *immediately available* from our stock at *regular, low, standard prices.*

Our hand operated punches, cutters, and benders are well known in many of the metal-working trades for their sturdiness and versatility.



Punch



Cutter



Bender

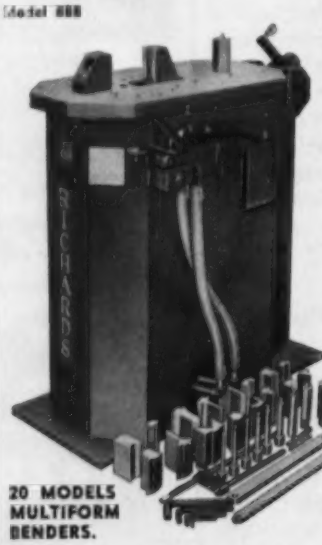
SEND FOR CATALOG SHEETS ON OUR COMPLETE LINE
Manufacturers of metal-working tools for more than 66 years

T. H. LEWTHWAITE MACHINE CO., INC.
306 East 47th Street New York 17, N. Y.

Multiform

BIG BROTHER BENDER

Model BBB



20 MODELS MULTIFORM BENDERS.

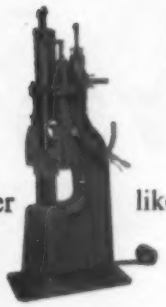


Illustrated above are a few of the many forms that can be produced efficiently on the Multiform Bender.

The heavy duty Big Brother Bender is designed for fabricating bus bars, brackets, fixtures, etc., without special tooling. Air controlled with finger tip response. Comes complete with dies, mandrels and wrenches—punching and blanking dies extra. Will punch holes up to 1" and form material up to ¼" thick by 4" wide. We also build hand or air models for forming up to ⅛" x 1½" material.

Send for illustrated folder I.A. 2

J. A. RICHARDS CO. 900 North Pitcher St. Kalamazoo, Mich.



In the good old days

When building a single frame 100-lb. hammer like this was a big job for our shop . . . we were buying advertising in a 40-year old publication called IRON AGE

today

When Erie Foundry has already completed its eighth 50,000-pound hammer – the largest forging hammers ever built – we're happy to still be buying space in 100-year old IRON AGE.



ERIE

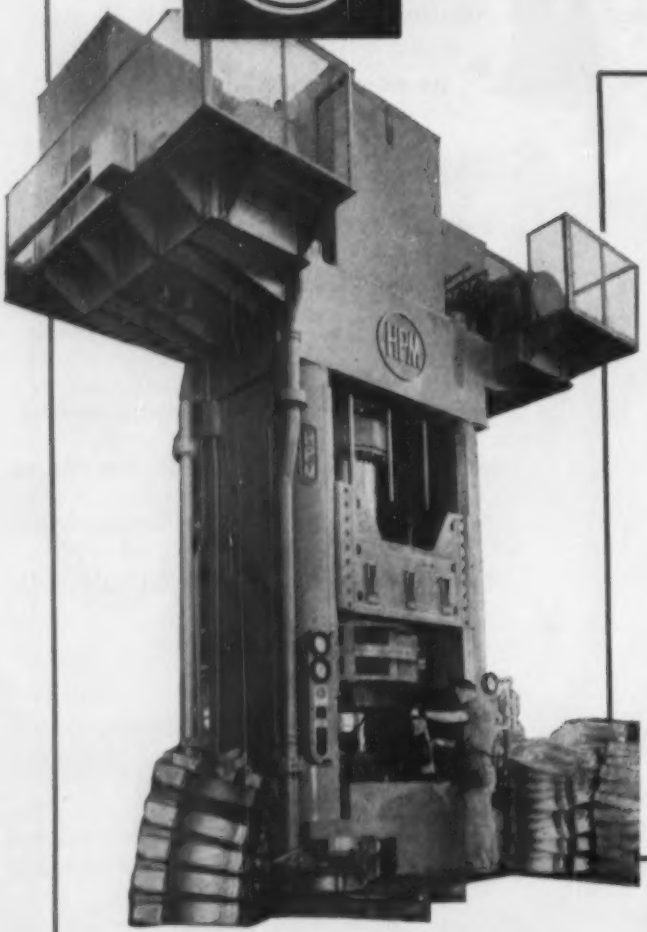
the greatest name in forging hammers

ERIE FOUNDRY COMPANY
—in its 60th year—
salutes IRON AGE—
in its 100th year.

ERIE FOUNDRY CO. ERIE, PA.

HPM

78 Years Experience





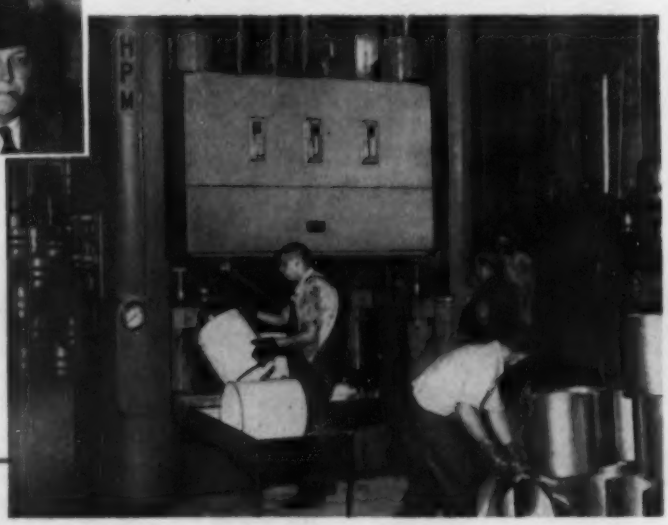
Mr. Ralph F. Mueller
Exec. Vice President
General Metal Products Co.

"We are pleased with our H-P-M. For years we felt we could do as well as anyone on depth and severity of draw but H-P-M has certainly broadened our scope in this respect—and at lower costs."

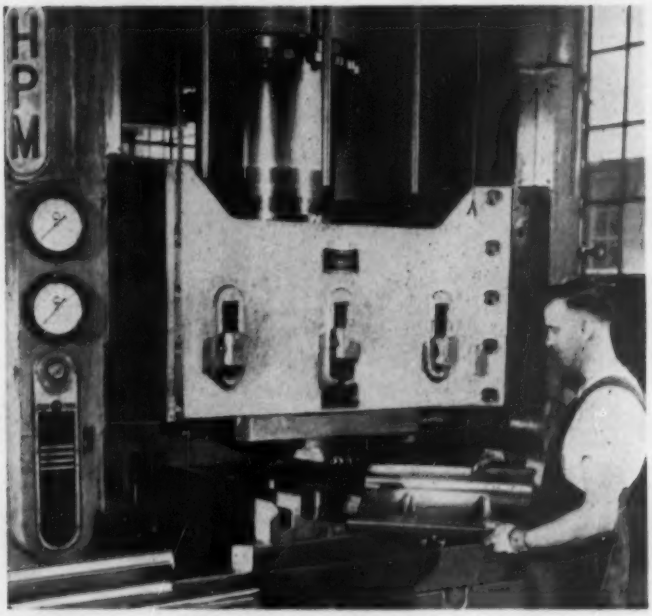


Mr. Thos. E. Adams, Jr.
Pres. & Treas. Beatrice Steel Tank Mfg. Co.
Beatrice, Nebraska

"We've used our H-P-M successfully for drawing aluminum, steel and stainless steel for commercial and military contracts. Work ranges from shallow pan draws to deep drawn stainless steel beer barrels. We're highly pleased with its record of continuous operation since 1945—without downtime or failures."



Behind These Installations





Mr. James H. Bragg
Factory Manager
Marshalltown Plant
of The Lennox
Furnace Co.

"We've operated our H-P-M 19 hours a day for the past several years without any downtime—it's the workhorse of the shop!"

Mr. R. V. Hansen
Plant Manager
Aluminum
Specialty Co.
Iron Mountain
Michigan



"Thanks to your very efficient presses and our competent workers, our hourly forging turnout has gone way above your press rated output and has even surpassed our own expectations. On a comparative basis the quality of our manufactured forgings is far superior to the quality of forgings we had purchased elsewhere. Downtime due to press failure has been negligible. Service-wise, performance-wise and production-wise — we highly recommend a hydraulic press investment in H-P-M."



THE HYDRAULIC PRESS MFG. COMPANY

Mount Gilead, Ohio, U. S. A.

HPM



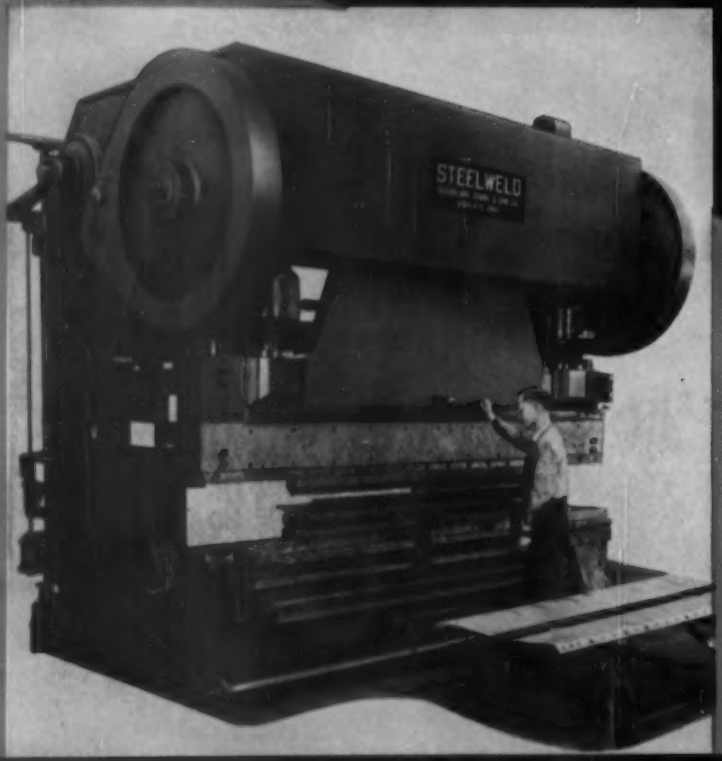
Two-Point Straight-Side Press



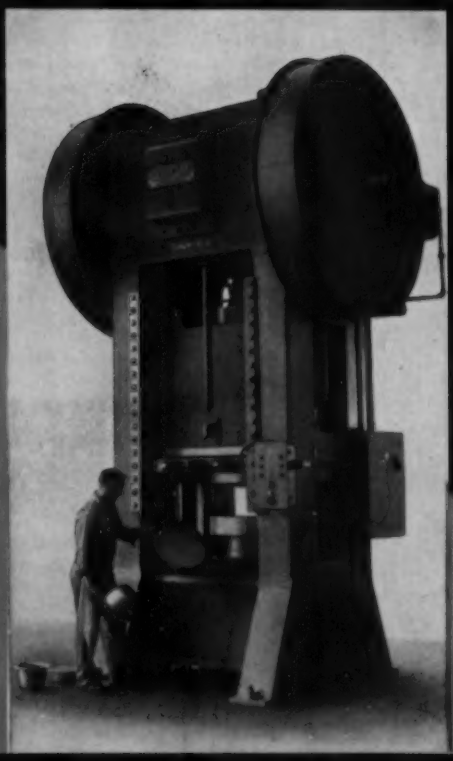
Single-Point Twin Drive

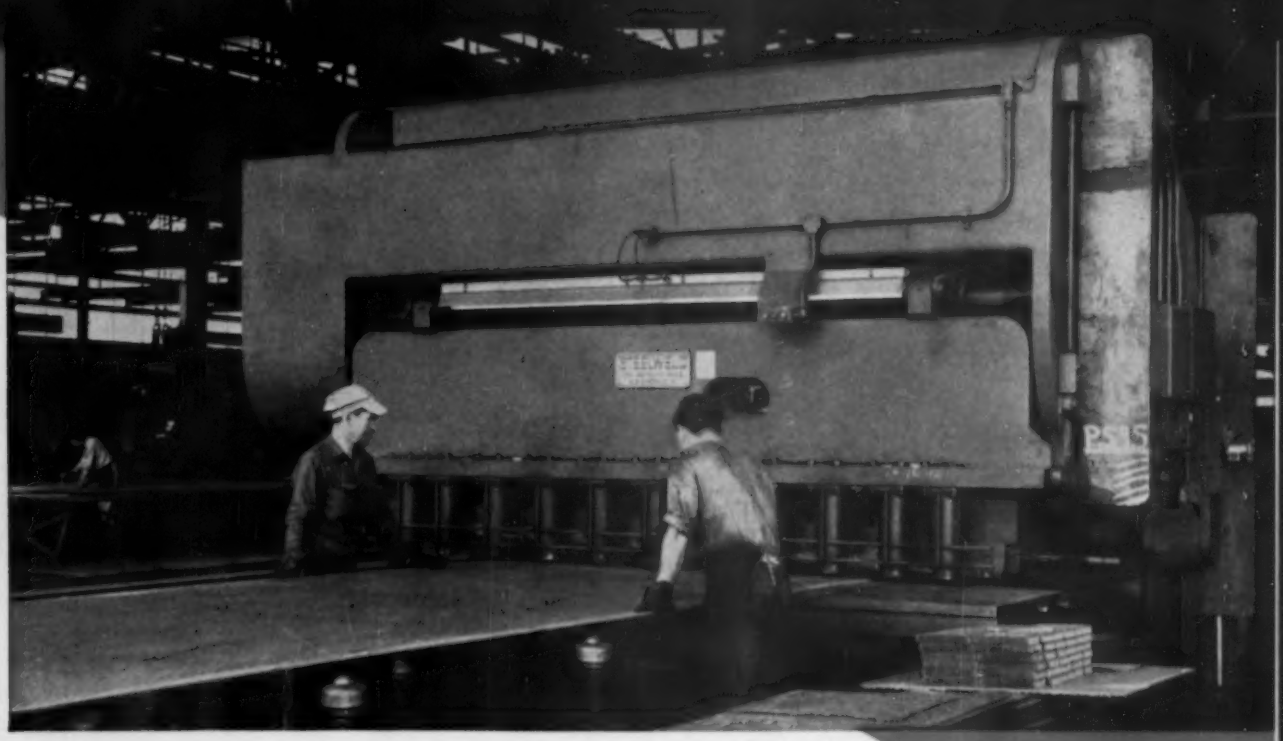
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PRESSES and SHEARS

Steelweld Bending Press



Single-Action Hi-Draw





Pivoted-Blade Shear

A BROAD LINE of Steelweld Mechanical Presses and Shears is available to serve you. All machines are built for heavy duty, continuous operation. Latest features required for high-speed, mass-production runs are provided. Design is generous throughout for long life and low maintenance.

Steelweld forming presses range in size from 150 tons up. Bending presses and shears available for plate thicknesses to 1¼" and lengths to 24'-0".

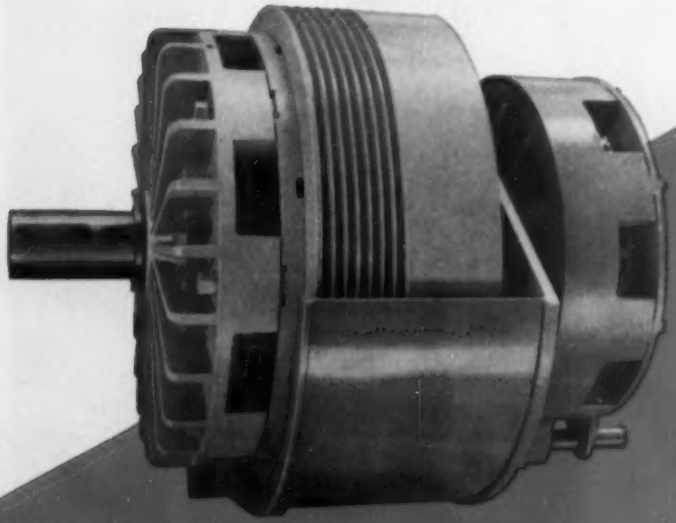
Descriptive information giving details on any or all of the machines illustrated will be gladly sent upon request.

Representatives in all principal cities

THE CLEVELAND CRANE & ENGINEERING CO.

4861 East 281 Street • Wickliffe, Ohio

Single-Point Single-Drive

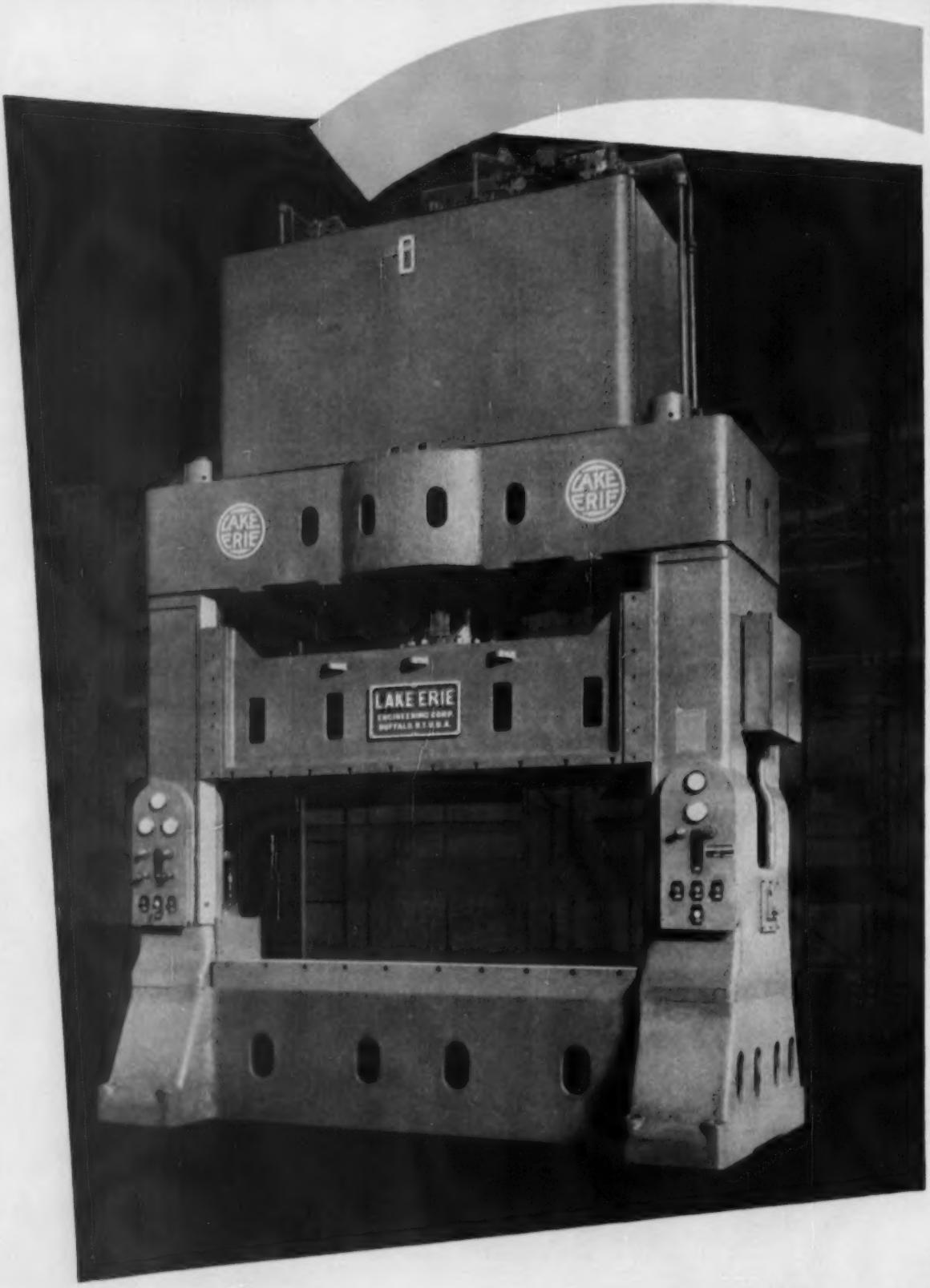


Outstanding UNITIZED *Clutch and Brake*

Steelweld's own air-operated design, with low inertia and fast heat dissipation, has been fully proven under rigorous conditions. Clutch, brake and flywheel are built together as a unit for quick, easy removal or replacement.



DESIGN POLICY IS THE



KEY TO SUPERIOR PRESSES

FORGED STEEL CYLINDERS... *eliminate possible failure of integrally cast cylinders.*

HEAVIER SECTIONS... *mean lower stresses.*

LAPPED CYLINDERS AND PISTONS... *insures precision fit.*

QUICK-SET STROKE CONTROLS... *save time on set-ups.*

UNUSUALLY RUGGED SIDE HOUSINGS... *increase frame rigidity.*

FAIL-SAFE DEVICES... *in electric and hydraulic circuits.*

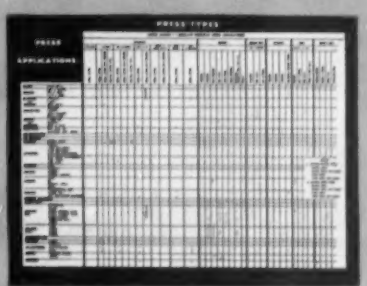
SIMPLIFIED ELECTRICAL SYSTEM... *designed for maximum safety and ease of maintenance.*

BRONZE USED EXTENSIVELY... *bronze throat bushings provide better guiding.*

... *bronze piston heads, gland bushings, and pre-fill valve disc prevent scoring.*

LAKE ERIE BUILDS THEM BETTER... Mechanically, electrically, and hydraulically, Lake Erie presses bring you the greatest number of superior features. That's why Lake Erie press users almost always return to us for additional presses. They know from experience that Lake Erie incorporates many "special" features as "standard"... features which seldom if ever form a part of customer specifications. They know that these features mean longer press life, minimum maintenance, maximum productivity. Next time, call on Lake Erie.

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LAKE ERIE®



Where Steel Becomes Curvaceous

To achieve the sleek, graceful lines of today's modern automobile fenders like those in the photo demands the ultimate in technical skills and quality materials. Take, for example, the process of cold-forming this front fender from cold rolled sheet steel supplied by Pittsburgh Steel Company.

This precise process is possible only when the steel has the proper internal and external qualities that let it flow evenly and true to form under tremendous pressure of deep drawing dies. The sheets must be uniform—sheet after sheet.

• **How Is This Possible?**—Good internal quality of the steel, proper chemical analysis, elimination of inclusions in the steel, control of grain structure—prevent stretcher strains from appearing in the surface of the fender. It prevents lamination, seams, rough grainy surface and even tears and breaks in the steel.

The surface of the steel must be free of external defects and its thickness controlled to within a few thousandths of an inch to work properly to the exacting limits of the dies. This assures even flow of the steel to all parts of the dies, prolongs the life of the die.

• **Good Steel Pays**—When you consider how steel sheets must perform in modern machines it is easy to understand why automakers who insist on top quality steel buy from Pittsburgh Steel Company.

The extra attention to quality at Pittsburgh Steel gives you cold rolled sheet that makes possible higher yield and fewer rejections on your production lines. It makes possible longer die life, less finishing and at the same time improves the quality of your product.

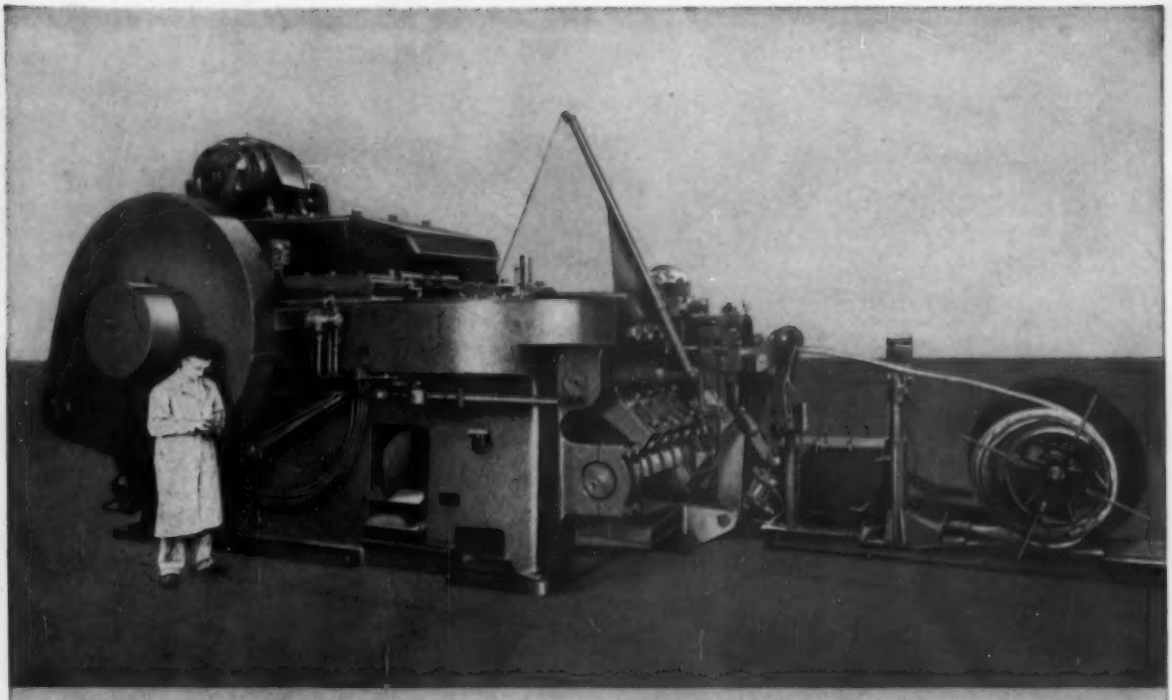
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AUTOMATIC FORGING MACHINES!

This is the largest high-speed automatic cold-forming machine yet built, and larger ones are in the works.

Using 1-1/2-inch diameter coiled hot-rolled stock, this 200,000 pound machine, designed and built by NATIONAL, automatically produces 40 clean, accurate parts per minute!

Through the years we have teamed up with industry on many novel automatic hot and cold forging installations — for making a wide variety of fasteners, automotive and aircraft components, and other parts.

If you need to make metal parts faster, stronger and at lower cost, let us work with you. Send us your prints and samples, or better yet, visit us. No obligation.

NATIONAL
MACHINERY COMPANY
TIFFIN, OHIO — SINCE 1874

DESIGNERS AND BUILDERS OF MODERN FORGING MACHINES • MAXIPRESSES • REDUCEROLLS • COLD HEADERS • BOLTMAKERS • NUT FORMERS • TAPPERS • NAILMAKERS

Hartford Detroit Chicago

Our first advertisement in The Iron Age:-



50 YEARS AGO

In September 1905 we placed our first advertisement in The IRON AGE. Advertising of Chambersburg products has appeared continuously in this magazine since that time.

The great growth of the United States industrially in the half century that followed has been happily reflected in the growth of the Chambersburg Engineering Company.

CHAMBERSBURG
SINCE 1897

CHAMBERSBURG
CHAMBERSBURG



TODAY AND TOMORROW

The next 50 years promises to bring even more astonishing achievements in industry than those which characterized the past 50, and the half-century preceding that.

Among these will be complete automation in forging, now being accomplished through the introduction of the Chambersburg Impacter and the development of Cecomatic Forging.



CECOMATIC FORGING



ENGINEERING CO.
PENNSYLVANIA

Coins and sizes powder metal pinions with **DENISON MULTIPRESS®**

Powder metal and Denison hydraulic Multipress enable The National Cash Register Co., Dayton, Ohio, to make small pinion gears more accurately, yet faster than before.

Using powder metal, pinions are now made in only 12 operations where formerly 22 operations were needed. One stroke of the hydraulic Multipress smooths, burnishes and strengthens the sintered surfaces. The operator has only to load pieces on the Denison Dial Feed Accessory which indexes them into position under the ram.

The Denison hydraulic Multipress improves production efficiency on countless applications where powder metal is used. Have a Denison Hydraulic Engineer study your operations and show where Denison can save you money. Write . . .

THE DENISON ENGINEERING COMPANY
1242 Dublin Road, Columbus 16, Ohio

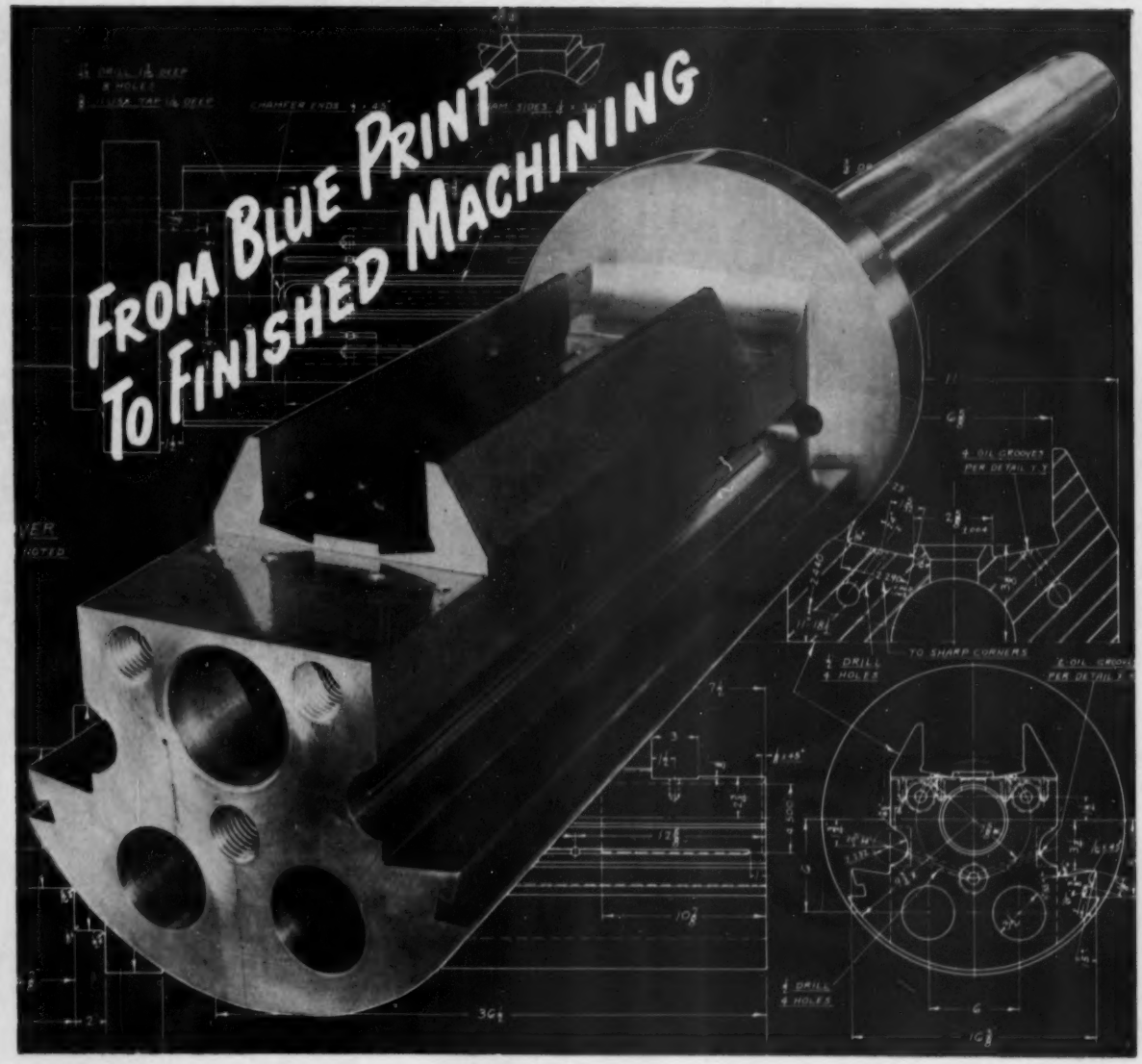
DENISON Hydr OIL ics



HYDRAULIC PRESSES • PUMPS
MOTORS • CONTROLS



Multipress and Dial Feed Accessory show coining punch ready to press powder metal component through die for sizing and coining.



This block Body for a Tension Reel represents the coordinated effort of many National Forge skills in turning out the required electric alloy steel, the proper heat treating and the intricate machining to exacting tolerances.

National Forge offers you complete forging service in one plant — under one responsibility.

Why not take advantage of this "all-in-one" service the next time you need forgings?

For full information, write NATIONAL FORGE AND ORDNANCE COMPANY, Irvine, Warren County, Pennsylvania.



NATIONAL FORGE AND ORDNANCE COMPANY

IRVINE, WARREN COUNTY, PENNSYLVANIA

EASTERN TOOL AND STAMPING CO.



Typical example of 1-piece stamping from ⅛" thick by 7¾" diameter brass blank.



Here is a one-piece stamping that makes up into a hand stapler part.

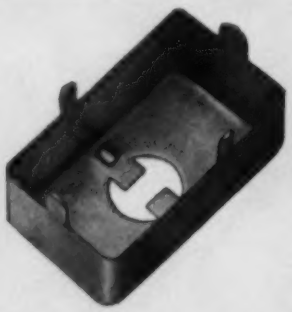
STAMPING SPECIALISTS IN DEEP DRAWING WORK - ALL METALS - ALL INDUSTRIES



Typical intricate one-piece stamp.



Notice the reduction in this 4⅛" long by ½" O.D. tube with 1⅛" flange.



Difficult switch part for automotive industry.



Bulb base for photo flash lap and seam produced by high-speed process.



Intricate vibration mount parts for industry.



Spring tempered phosphor bronze switch contact — note flat fold-back feature.

ETS **EASTERN TOOL AND STAMPING CO., Inc.**

PRESSED METAL ENGINEERS
DIES AND STAMPING

SAUGUS MASSACHUSETTS



Two Verson 1500 ton fast operating Eccentric Presses head these cold extrusion lines served by Verson engineered automation.

Anyone can build a press...

Verson builds production processes

that lower your unit costs...

TURN THE PAGE FOR MORE

Imagination...ingenious tooling...

THE Verson COMBINATION THAT ASSURES BETTER STAMPINGS AT

Anyone can build a press . . . it's what that press can be made to do that is important. At Verson, press and tooling design problems are approached with imagination. To just build a press isn't enough . . . it is our constant goal to seek and find better and more efficient means of production even if it means a complete departure from conventional practices.

We are proud of the many advances in the art of press forming metals that this philosophy has made possible. Starting with the first welded steel frame, Verson imagination has led to many revolutionary developments . . . larger, more efficient presses . . . completely automatic Transmat forming . . . higher speed, progressive forming . . . perfection of the Wheelon process of rubber pad forming . . . extrusion of artillery shells.

Shown on these pages are just a few examples of how Verson imagination, combined with quality presses and ingenious tooling has made possible superior production processes. We would like the opportunity to show you what Verson imagination can do when applied to your production problems. It may open the door to improved efficiency and lower costs for you.



fine presses

OWER COST



ABOVE—In modern production processes, tooling is often the key to more efficient production. Verson has led the way in the development of cost-cutting tooling and automation.

LEFT—A small part of a large component manufacturing plant that is 100% equipped with Verson Presses. 47 Verson machines are now installed and preparations being made for 7 more. Key Verson units are a group of 2500 ton double action presses.

RIGHT—Verson-Wheelon direct acting hydraulic presses have revolutionized rubber pad forming processes. Not only have they reduced initial investment, but they permit use of higher forming pressures and produce far superior parts. The press shown has a rated capacity of 21,000 tons.

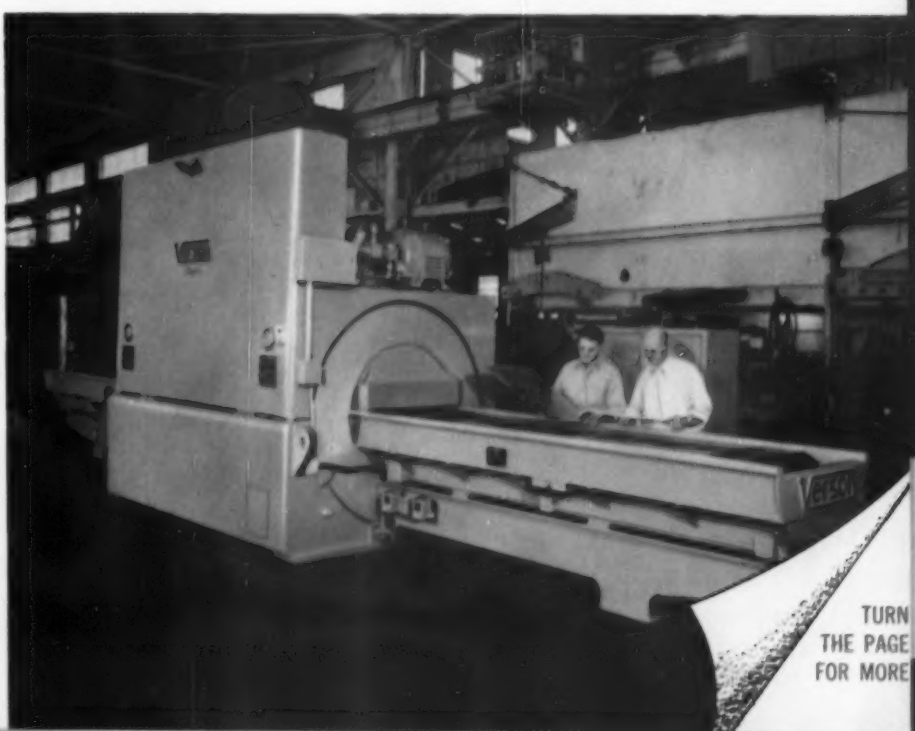
Open House

at Verson during the Machine Tool Show, September 6 to 17—

You are cordially invited to visit the Verson plant while you are in Chicago for the Machine Tool Show. Verson presses will be in operation for your examination in our new Research, Development and Exhibit Center. Transportation can be arranged from the Show or from your hotel.

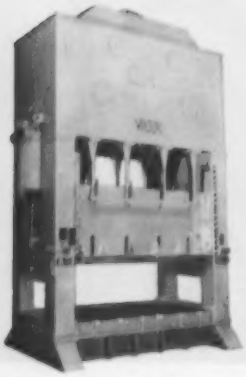


ABOVE—Transmat forming is the Verson concept that has revolutionized mass production of stampings requiring four or more operations. The Transmat Press shown is a good example. It is part of a Verson tool-up for automatically producing 1000 automotive air cleaner shells per hour.

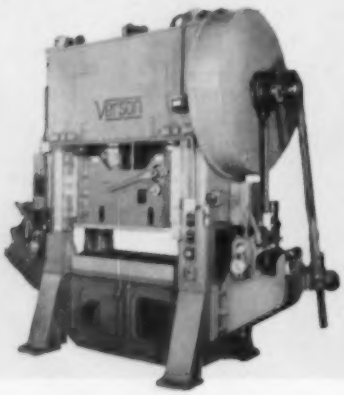


TURN THE PAGE FOR MORE

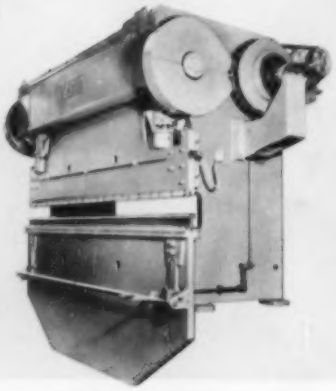
A Verson PRESS FOR EVERY JOB FROM 60 TONS UP



Verson Straight Side
Eccentric Presses



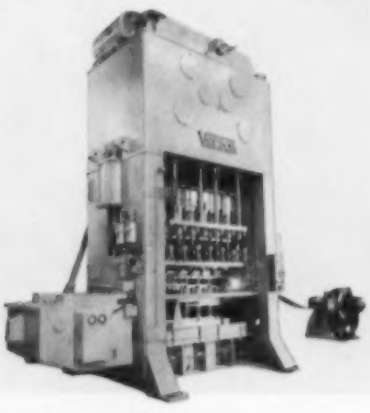
Verson High Speed,
High Production Presses



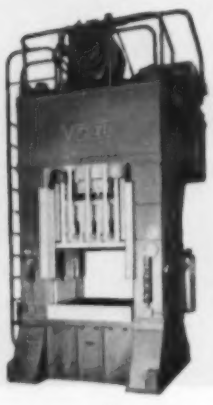
Verson
Press Brakes



Verson Straight Side
Crank Presses



Verson
Transmat Presses



Verson
Hydraulic Presses

● The complete Verson line includes not only the presses illustrated on these pages but virtually all other types as well, including an extremely wide variety of special machines. More than thirty years of research and development are behind today's Verson Allsteel Presses. Incorporating all the advanced engineering features that have won them their reputation for top quality performance, Verson Presses are constantly being tested, refined and improved so that they may continue to lead the way in making possible improved processes.

Whatever your production problems, if they involve the press forming of metals, bring them to Verson. Here your press requirements will be treated as an integrated part of your whole production process. As a manufacturer of practically every type of press we can recommend, without prejudice, the combination of machines that will best fit your overall requirements.

To put these facilities to work for you, just send an outline of your needs.

Verson

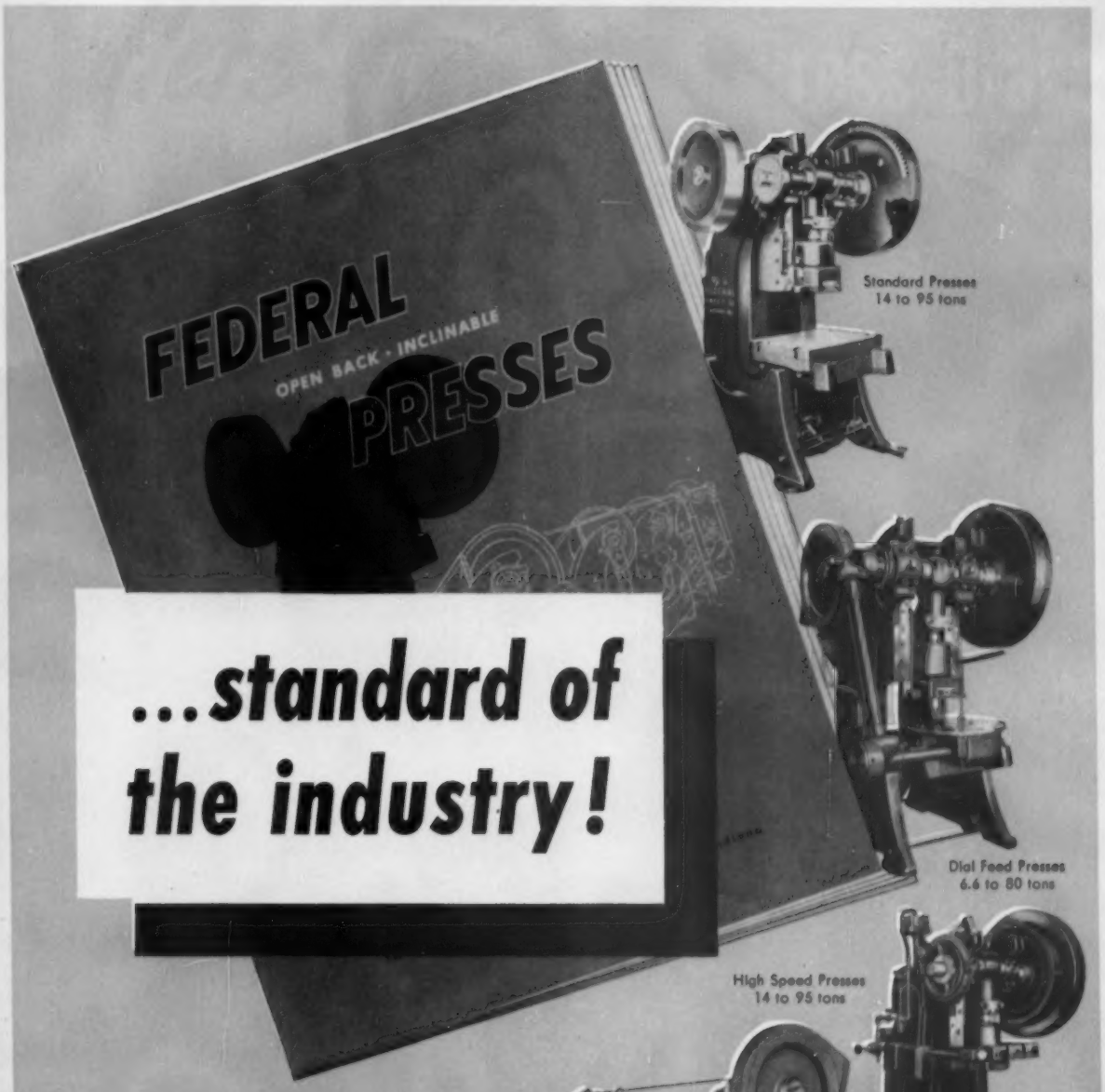
ORIGINATORS AND PIONEERS OF ALLSTEEL STAMPING PRESS CONSTRUCTION

VERSON ALLSTEEL PRESS CO.

9300 S. KENWOOD AVENUE, CHICAGO 19, ILLINOIS • SO. LAMAR AT LEDBETTER DRIVE, DALLAS, TEXAS

MECHANICAL AND HYDRAULIC PRESSES AND PRESS BRAKES • TRANSMAT PRESSES • TOOLING • DIE CUSHIONS • VERSON-WHEELON HYDRAULIC PRESSES

PRINTED IN U.S.A.



...standard of the industry!

Federals have earned this reputation for leadership by meeting industry's demands for faster, safer, more economical production. These high quality presses are offered in four major classes—

Standard Presses **Dial Feed Presses**
High Speed Presses **Special Presses**

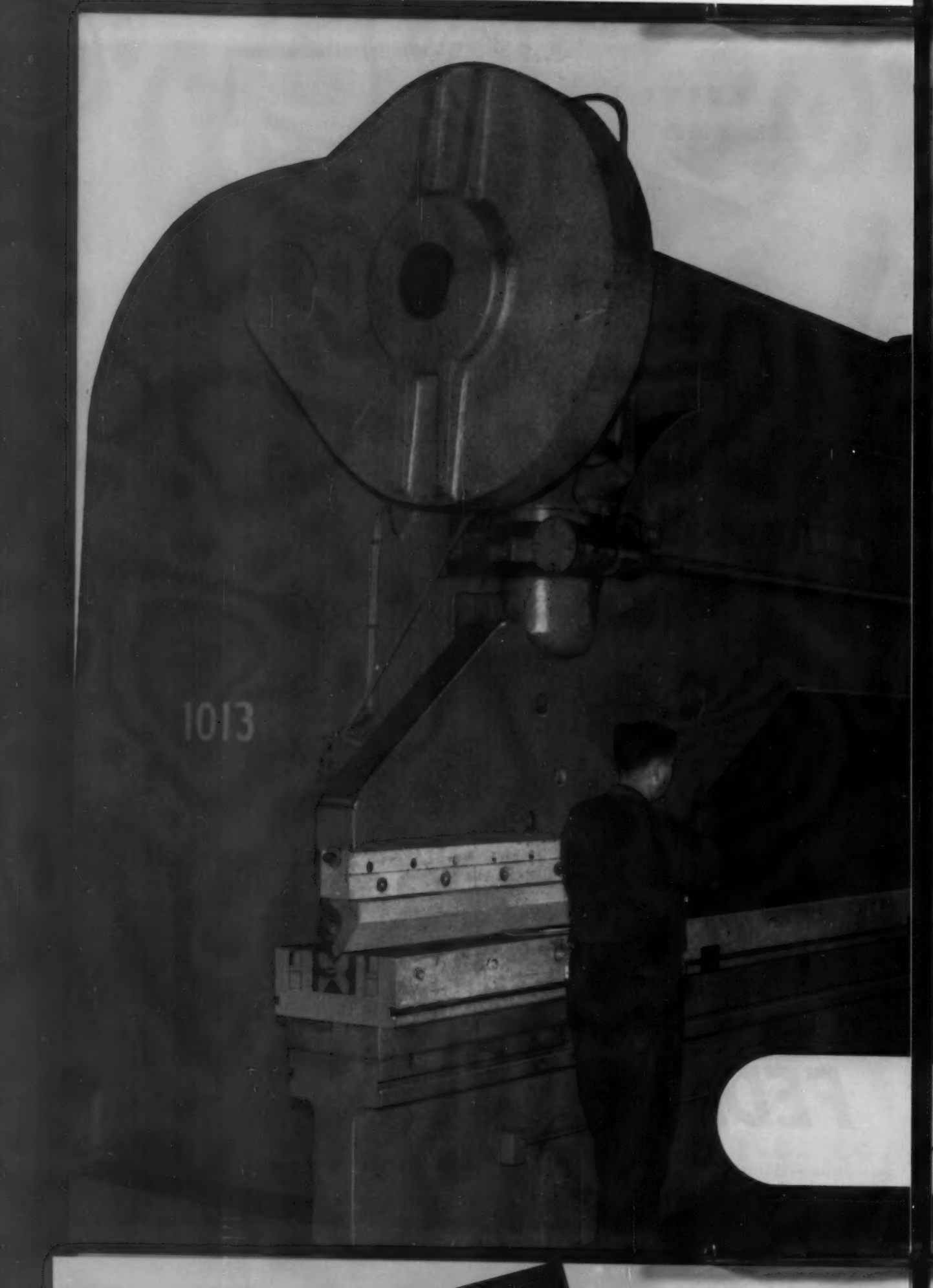
The new Federal catalog contains complete details and illustrations, shows unusual applications and how to select presses of proper capacity. This catalog should be in your files.

Write For Free Copy Today!

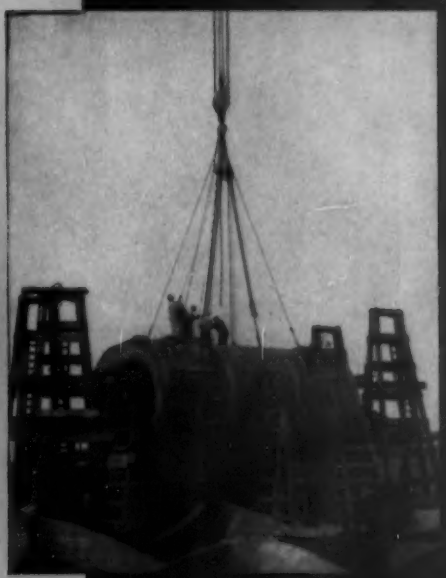
THE FEDERAL PRESS COMPANY
502 Division Street, Elkhart, Indiana

FEDERAL *Open back Inclinable* PRESSES

30 YEARS OF QUALITY CONSTRUCTION


1013

Here- a Cincinnati Press Brake saves 3 ways...



1. TIME
2. NUMBER OF OPERATIONS
3. MATERIAL

Built at The Maryland Drydock Company, these giant condensers for the Westinghouse Electric Corporation are some of the largest ever constructed.

Photographs courtesy of The Maryland Drydock Company, Baltimore, Maryland

Crimping plate up to 3" thicknesses has cut roll-forming time in half at The Maryland Drydock Company.

The press brake crimps the ends of the plates with special dies, and has eliminated both the costly burning operation, and the loss of 15" to 18" of the ends of the plates.

Some of the large radius bends are done entirely on the Cincinnati Press Brake.

Write for the NEW 72-page Press Brake Catalog B-4.

THE CINCINNATI SHAPER CO.

CINCINNATI 25, OHIO, U.S.A. SHAPERS • SHEARS • BRAKES

CINCINNATI

"CINCINNATI" shears 24 feet of ¼ inch plate

...straight and true!



Cincinnati Shears, built with machine tool accuracy and exceptional rigidity, cut to close tolerances even on the longest cuts.

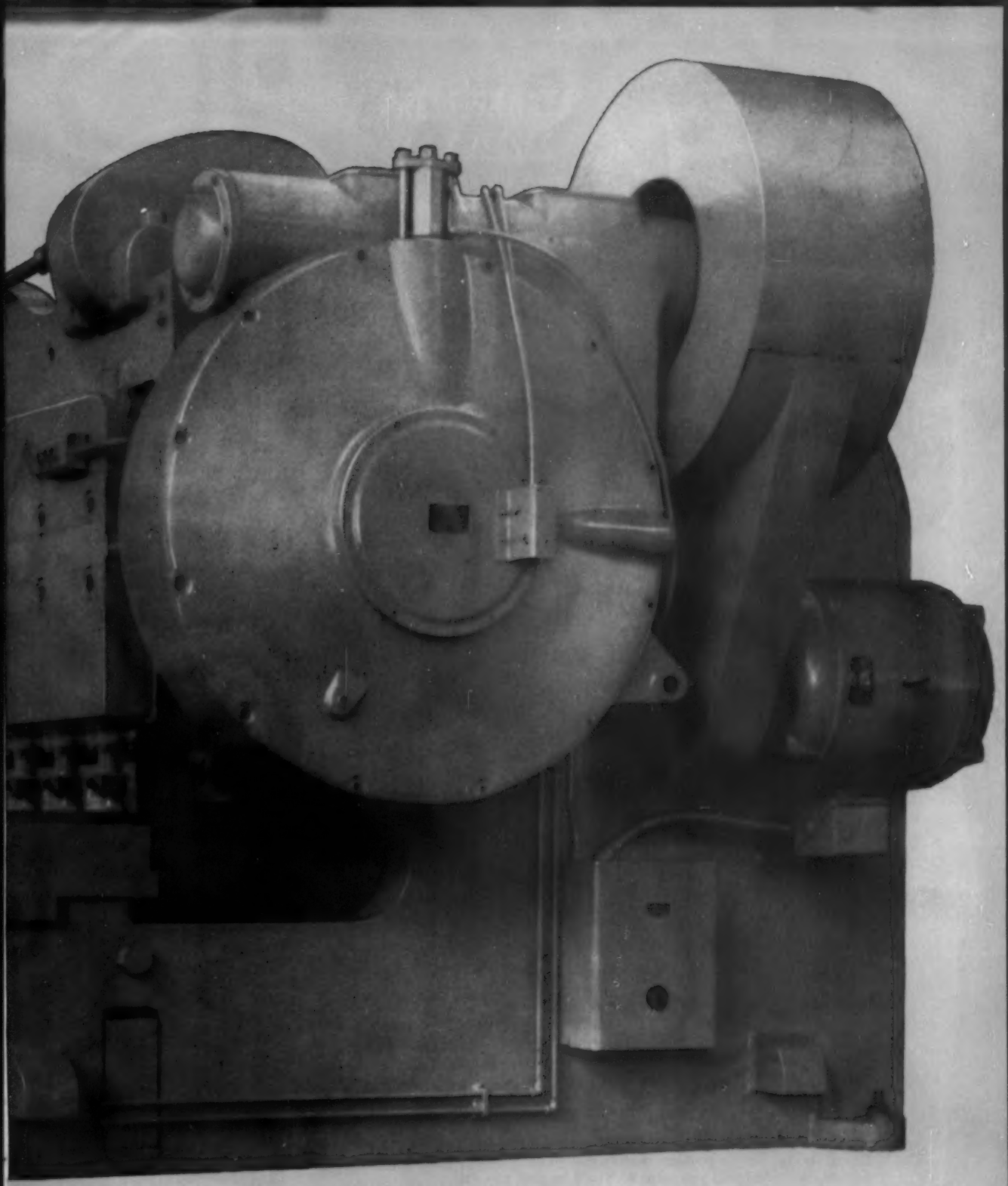
Built in lengths from 4 ft. to 24 ft., they shear .005" thick sheets to 1¼ in. plate with micrometer accuracy. They handle a wide variety of materials ranging from soft aluminum to armor plate.

Write for complete shear catalog S-6.

CINCINNATI

THE CINCINNATI SHAPER CO.

CINCINNATI 25, OHIO, U.S.A. SHAPERS • SHEARS • BRAKES



■ Cincinnati 10024 Series Shear capacity ¼ in. mild steel 24 ft. long.



To our Favorite Boss!

From the receptionist at the front door through to the last man on the loading platform—*all* of us here at Great Lakes Steel have a very important *something* in common. It is the knowledge that your continued and expanded need for our products determines the future and growth of every one of us, regardless of our individual jobs here.

It is the knowledge that *you*, Mr. Customer, are the boss!

That's why we at Great Lakes are seeing to it that our steel is the kind you have a right to expect from a specialist in flat-rolled products. We know the importance of prompt shipments, top quality, proper packaging and loading, dependable information, and clerical accuracy. We think you'll agree that our many satisfied customers are a pretty good indication that this policy is good business for all concerned.

Next time you have a problem in steel, call on one of our representatives to help you solve it. You'll be glad you did!

GREAT LAKES STEEL CORPORATION
Ecorse, Detroit 29, Mich. • A Unit of
NATIONAL STEEL CORPORATION

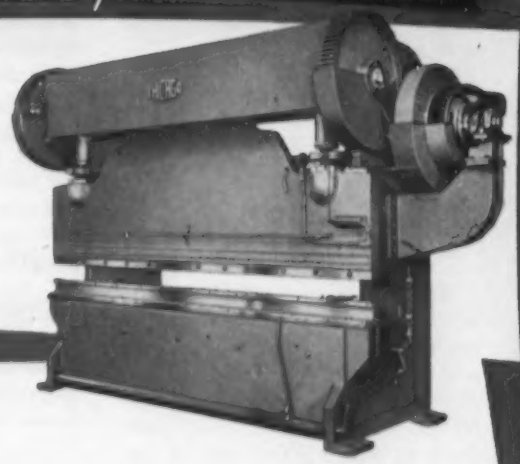
SALES OFFICES IN BOSTON, CHICAGO, CINCINNATI, CLEVELAND, HOUSTON, INDIANAPOLIS, LANSING, LOS ANGELES, NEW YORK, PHILADELPHIA, PITTSBURGH, ROCHESTER, ST. LOUIS, SAN FRANCISCO AND TORONTO

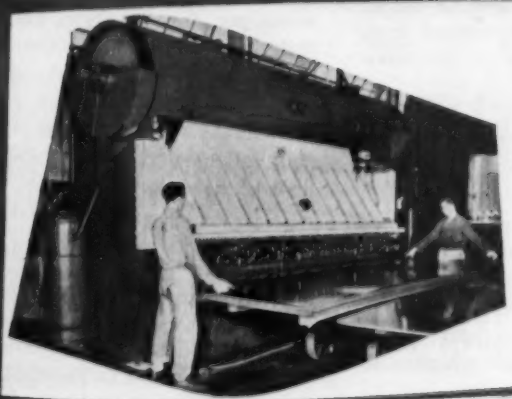
CHICAGO

PRESS BRAKES
SS PRESSES
With Large Die Area
FOLDING BRAKES
Single or Double Leaf
BENDING BRAKES

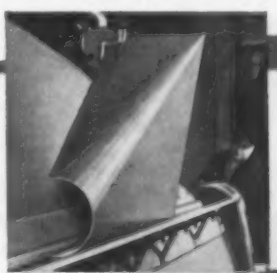
Beading
Bending
Blanking
Corrugating
Curling
Drawing
Embossing
Forming
Joggling
Notching
Punching
Shearing
Slitting
Trimming

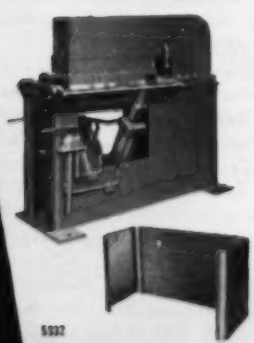
The Series D Heavy Duty CHICAGO Press Brake. There are 42 standard sizes of CHICAGO press brakes in capacities for bending sheet metal 48 inches by 18 gauge and steel plate up to 8 feet by ¼ inch or 16 feet by 7/16 inch. The design of any model CHICAGO press brake can be modified to meet special conditions.



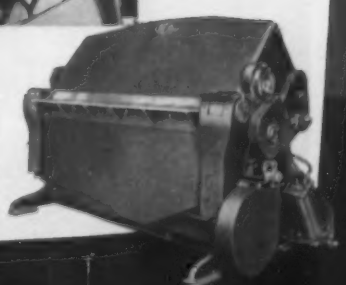


A Series D CHICAGO SS Press with die area 50 inches by 14 feet for handling over 100 punching and notching operations in a single stroke on sheet steel. Other models of CHICAGO SS Presses with large die area have capacities from 30 to 400 tons.





The CHICAGO Power Folding Brakes are made with single or double leaf to suit individual requirements for either sharp or radius bends on liners and outer shells for stoves, freezers, unit heaters, cabinets, hot water heaters, air conditioner units, television cabinets, refrigerators, etc.



CHICAGO Power Bending Brakes for single or quantity runs bending sheet metal and steel plate. Standard sizes range from 4 to 16 feet in capacities up to ¼-inch plate.

Full particulars on any of these machines and recommendations for any job on request.

DREIS & KRUMP

MANUFACTURING COMPANY
7340 S. Loomis Boulevard
Chicago 36, Illinois

Early Glass Works

The following scrap of information is taken from a pamphlet issued by the Rochester Tumbler Company: The first glass house in Pittsburgh was in operation in 1797; now she has within her limits and vicinity 78 factories, containing 80 furnaces, having 747 pots; the buildings cover an area of 210 acres, giving employment to over 5450 hands.

Nov. 9, 1876

Pittsburgh Pirates

Manufacturing establishments on the river have met with many losses recently through thieves who ply their vocation in boats. The mode of operations has been for one of the plunderers of each gang to loaf around one of the mills, and, when opportunity offers, throw pieces of iron over the cinder piles to the edge of the water. Then the practical individuals in skiffs capture the metal and make way with it for sale to scrap dealers.

Nov. 9, 1876



Bettmann Archive

FORGING in an American iron mill about the middle of the last century.

New Tinplate Plant A Welcome "Surprise"

According to Noah Webster a surprise is "something unexpected." Therefore, the Pittsburgh Crucible Steel Co., a subsidiary of Crucible Steel Co. of America, may rightfully assume that it is about to deal out a welcome surprise to the tin plate consumer. For at Midland, Pa., this company has quietly erected a large plant; it has installed a reversing cold mill, a vertical electrical annealing furnace, a number of coilers and uncoilers, a large complement of plating tanks, an electrical sub-station and other auxiliary machines. This building and this equipment comprise the first commercial venture for the electro-deposition of tin onto strip steel. It is a confident step by a tyro in the tin plate game that it will succeed in an operation which entrenched companies have hesitated to undertake.

Yields Better Product

This week, Crucible, for the first time, will fasten 5000-lb coils of 20-in. cold-reduced strip end-to-end and start the steel on its journey through tin plating baths and processing equipment. Ingots will be reduced to blooms at Midland, the blooms sent to a nearby continuous hot mill for reduction to strips, and the strips returned to Midland for cold rolling on a 26-in. reversing mill. At the discharge end the company states it will have a continuous roll of tinned strip steel with the following laboratory-established attributes: (1) Continuous and uniform coating, (2) dense and lustrous tin structure with almost complete freedom from pores, (3) elimination of pickling embrittlement and concomitant improvement in deep drawing qualities, (4) a surface layer of pure tin; therefore improved corrosion resistance, and (5) avoidance of grease lines, mottle and isolated $FeSn_2$ crystallites.

Thus it is not impossible that the conventional hot-dip tin plate industry may have an incipient revolution on its hands—the first radical change in a product which has been familiar for centuries and is today made in essentially the same manner as it was in 77 A.D., at which time Pliny the Elder mentioned hot-dip tin coatings in his "Natural History."

July 2, 1936

Large Steam Condenser

What is said to be the largest steam condenser ever built was recently completed by the South Philadelphia works of the Westinghouse Electric & Mfg. Co. It will be installed in the new Richmond station of the Philadelphia Electric Co. It will be able to circulate nearly 150,000,000 gal of water per day, or about half the daily consumption of Philadelphia. It stands nearly 30 ft high, weighs almost 1,000,000 lb and has a cooling surface of 70,000 sq ft. More than 21 miles of tubes are included.

Aug. 13, 1925

ACKNOWLEDGMENT

In addition to those mentioned in the text or in photo credits, the editors also want to thank the following for their help in preparing this section:

E. V. Crane, Chief, Special Engineering, E. W. Bliss Co., Copper & Brass Research Assn., Drop Forging Assn., National Machine Tool Builders Assn., Abdite Tool and Gage Co., Ajax Mfg. Co., Babcock & Wilcox Co., Baldwin-Lima-Hamilton Corp., Chambersburg Engineering Co., Chrysler Corp.: Dodge Div., Dodge Forge Div.; Denison Engineering Co., A. Finkle and Sons, Ford Motor Co., General Motors Corp.: Buick Motors Div., Fisher Body Div., GM Research, GM Technical Center, Pontiac Motor Div.; The Hydraulic Press Mfg. Co., The National Machinery Co., Ohio Crankshaft Co., Tocco Div., Olds Motor Works, Packard Motor Car Co., Parker Rust Proof Co., Ren-Ite Plastics, Inc., Rezolin Corp., The V & O Press Co., Worcester Pressed Steel Co.

Eriez Permanent Magnets

to CONVEY . . . HOLD . . . CONTROL

offer new automation advantages

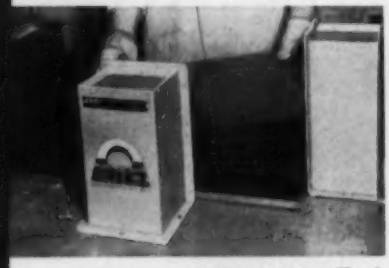
• A revolutionary new concept in steel conveying and controlling is now possible through the use of Eriez Permanent Non-electric Magnets. Famous for years as magnetic separators to remove tramp iron from processing lines of all kinds, the introduction of these magnets into the metal working industry has offered many new ideas in automation. Powerful enough to stop moving metal, these magnets can also convey pipe, tubes, conduits, sheet metal, etc., at high speeds to maintain peak production. Other advantages include: faster pickup, more positive movement, less conveyor space needed, less product damage caused by slippage and sag, elimination of electric motors, etc. *All Eriez Magnets are non-electric, self-contained. They have no wires or attachments. There is no operating cost; first cost is the last. Powerful Alnico V elements are guaranteed to keep their strength indefinitely.*

Write for Big New "MAGNETS FOR METAL WORKING" Bulletin.

Magnetic ideas from ERIEZ



AND HOLDING ON BY A MAGNET. There's quite a drop beneath this worker . . . but he's in no danger. He is holding on by a permanent-powered Eriez Magnet. This idea of permanent dependability and herculean power now offers the metal working industry many new ideas for automatic control and conveying of steel. Hundreds of other production problems have also been solved by the use of many types of Eriez Permanent Magnets designed to separate, retrieve and purify.



ERIEZ SHEET FANNER MAGNETS. Here's the magnet to speed up sheet metal handling and increase production. Slow, costly hand separation is completely eliminated . . . no more double feeding, no scratched surfaces, no cut fingers. An Eriez Sheet Fanner Magnet placed next to a pile of sheet metal *automatically* lifts the top sheet into the air, allows fast, safe removal. When this sheet is removed, the following one automatically rises. Ideal for irregular, odd-shaped sheets. Available in five strengths.



ERIEZ SMALL-DIAMETER MAGNETIC ROLLS (flat-faced). These powerful, permanent magnetic rolls are destined to play a major part in plant automation. Installed either singly or in groups, they are used for feeding, conveying and spot control of sheet metal and they assure absolute control during such operations as baking, painting, trimming, etc. They eliminate drifting, untrue cuts, cobbles . . . reduce downtime and rejects. They permit automatic feeding of stock for cutting, punching and shearing operations. Rolls can be coated for special needs, or chrome plated for longer wear. In $2\frac{1}{2}$", 4", $4\frac{3}{8}$" and 5" diameters. Easily installed on present systems.

ERIEZ V-TYPE MAGNETIC PIPE CONTROL ROLLS. These V-grooved rolls are used to control and convey pipe from one location to another, either horizontally, vertically or up steep inclines at speeds that permit capacity production. They decrease take away time, make for shorter conveyor lines, and eliminate many direct drive rolls and motors. Positive hold prevents rebound, assures absolute control during all operations such as cut-off, reaming and facing, coupling, threading, and conveying through coating operations. Available for medium and heavy duty.



ERIEZ CONTROL PLATE MAGNETS (flat-faced). Designed for installation under fast-moving belts, powerful plate magnets are used to control moving sheets and keep them in proper position during conveying operations. True feeding into machinery is assured, and there's never a chance of flopping or "take-offs." Constant magnetic power prevents sheets from damaging each other, reduces rejects and waste. Available in various sizes and strengths, in widths from 4" through 72", in 2" increments. Readily adaptable to existing conveyor lines.



Eriez "Magnetic Ideas" can help you. Eriez factory-trained field men, backed by extensive laboratory and engineering know-how, will be happy to study your particular metal handling problem and offer helpful "Magnetic Ideas." Our representatives are always glad to work with your engineering department or consulting engineers on any problem, large or small. For additional information concerning magnetic problems in the metal working industry, write for new bulletin B-207. Address Eriez Manufacturing Company, 100T Magnet Drive, Erie, Pennsylvania.



RUGGED PRESSES

DESIGNED BY BLISS

FOR THE AGE OF AUTOMATION

Bliss "packaged presses," built to JIC standards, offer advantages like these

- All piping and wiring for press controls, automatic work-handling devices and maintenance tool power outlets are *built into the uprights.*
- Cuts installation time and costs—practically all the installation crew has to do with the press is "plug it in".
- Eliminates split responsibility for press performance—centers it instead on the press builder.
- Simplifies installation and maintenance of doper, cushions, lifters, Iron Hands and other work-handling devices.
- Leaves clean, uncluttered exterior—cranes can move up close to load or unload dies without bumping or snagging.

FOR MORE INFORMATION, WRITE

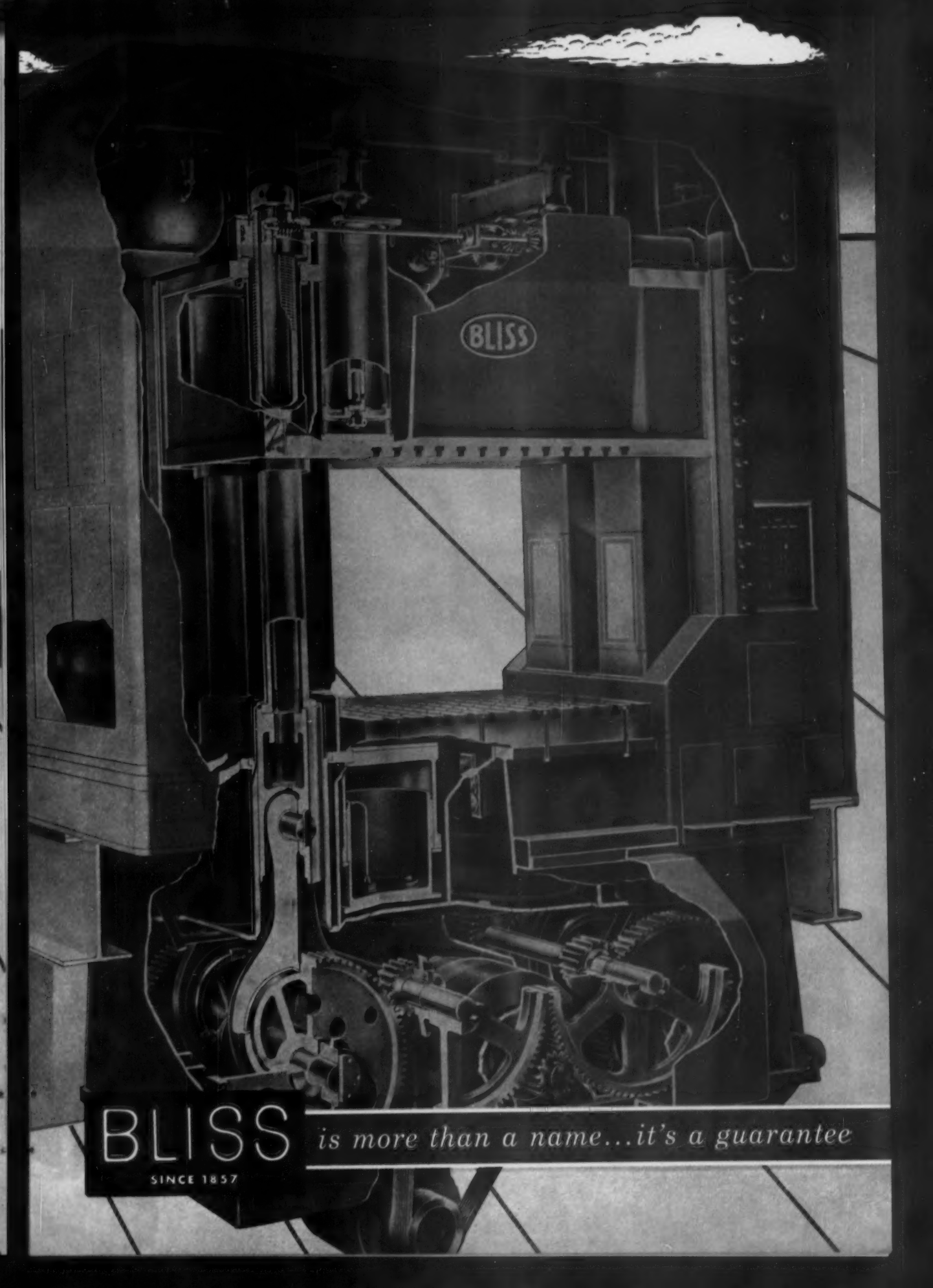
E. W. BLISS COMPANY, Canton, Ohio

Presses, Rolling Mills, Special Machinery

U. S. Plants in Canton, Cleveland, Salem and Toledo, Ohio; Detroit and Hastings, Michigan; San Jose, Calif.; Pittsburgh and Midland, Pa. Representatives in principal cities.

Beneath the sleek exteriors are these new design features—

- Heavy frame construction—For a century, Bliss has been known for its emphasis on heavy frames. With big presses like these, Bliss' heavy sections and internal ribbing easily take quick shock loads in stride.
- Extra-long gibbing—slide works entirely within gibs, even when adjustment is down. Motorized slide adjustment is self-braking, assures accurate positioning. Slide runs true at all times, meaning longer die life and greater accuracy.
- Integral gear and eccentric drive—its compactness allows gears to operate within the crown. No overhanging gear guards. And Bliss' design eliminates torsional deflection of main pin, minimizes distortions due to overloads.
- New automatic lubricating system—a recirculating type which has proved foolproof in service. Positive piston displacement method automatically lubricates every bearing surface at predetermined intervals. Electrical interlocks shut down press if a single feeder fails.
- Cool-running high speed clutch—Bliss' combination pneumatic friction clutch and brake is extremely fast—only a fraction of an inch needed between full engagement and brake. Self-aligning feature automatically compensates for wear. Clutch is also self-cooling.

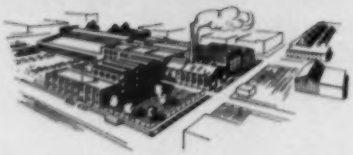


BLISS

SINCE 1857

is more than a name...it's a guarantee

Seventy-Five years

1880  1955

FOR OUR PART IN YOUR FUTURE!

Since 1880 we've been building machines for the metalworking industries. We're proud that our presses, fabricating tools and small tools contributed to the phenomenal growth of metalworking in the United States.

Our seventy-five years of close association with many of the countries leading industries have given us a thorough understanding of future needs for improved fabrication and stamping equipment. We've kept pace with the great technological advances of the past and are now prepared to build the machines you'll need in the future.

Proved by extensive and varied use, our patented Cleveland Clutch assures minimum down-time, positive, fast control and lower operating costs. It's available on any of the 11 types of Cleveland Presses.

The construction of all Cleveland presses is simple and powerful. They are designed for ease of adjustment, minimum wear of moving parts and economy of operation. For instance, the Cleveland Double Action Toggle Presses, shown on the opposite page, are so designed that when the blank-holder toggle arms are straightened out, the entire blank-holder pressure is transmitted directly to the press frame. This permits full use of crankshaft power for the drawing operation. Cleveland Double Action Toggle presses can be furnished either single or double crank in a wide range of sizes.

If you're planning to revitalize present stamping or fabricating lines or if you plan to start new production requiring these operations, won't you let us give you the complete Cleveland story? Just write or call today!

POWER PRESSES



TWO POINT



FOUR POINT



SINGLE POINT

Cleveland Single Point, Two Point and Four Point Presses can be furnished in a wide range of sizes, with bed area, die space, stroke and adjustment to suit particular requirements.

SMALL TOOLS

Punches-Dies, Rivet Sets, Chisel Blanks, Barrel Pins, Drift Pins, Center Punches.

FABRICATING TOOLS

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Small Tool Department

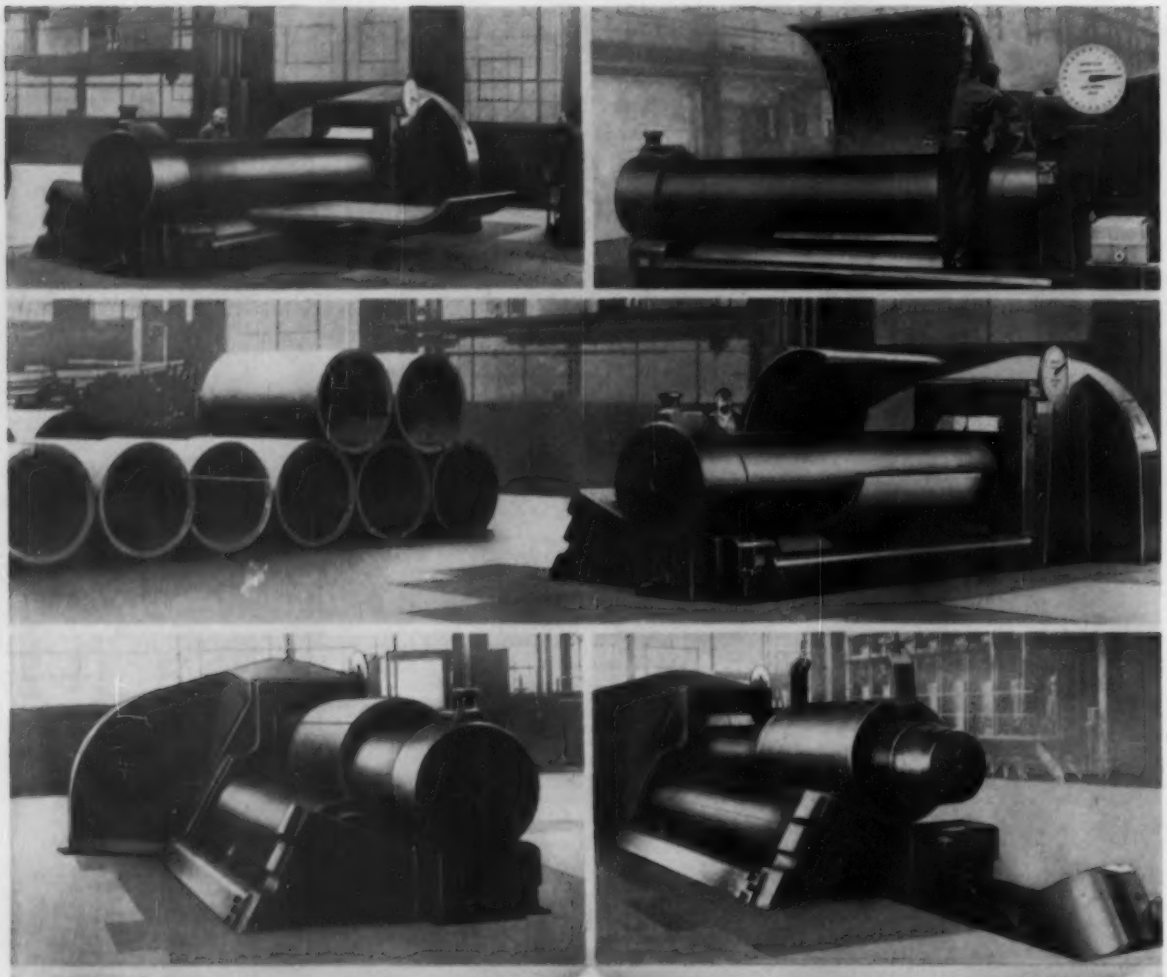


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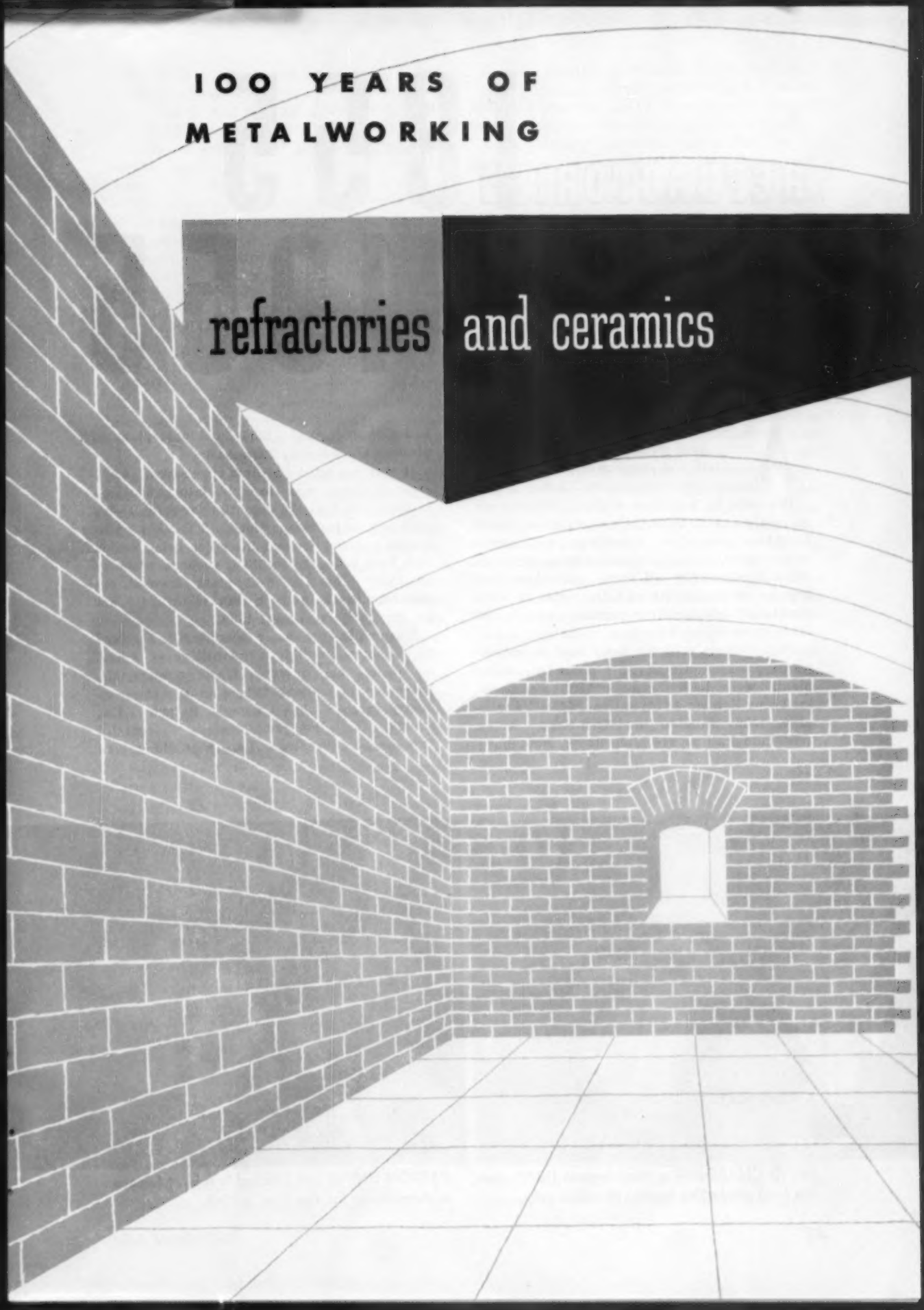
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100 YEARS OF
METALWORKING

refractories and ceramics



REFRACTORIES 1855 1955

AS "INDUSTRY'S INDUSTRY" refractories have occupied a front row seat at the birth and subsequent development of major industries in the United States. It's safe to say that without refractories, utilization of U. S. industrial potential would have been impossible. Ferrous and non-ferrous metals, utilities, glass, ceramics, transportation, oil, and chemicals—all these and others lean heavily on the ability of refractories to withstand high temperatures, corrosive attack, and other destructive influences.

Pennsylvania took an early lead in refractories production and still holds it. Many plants were built between 1850 and 1890, including Bolivar, 1842; Salina, 1845; Connellsville, 1859; Pittsburgh, 1865; Sandy Ridge, Woodland Philipsburg, Johnstown, Blandburg, and Cowanshannoc (1884), the first plant to produce silica brick continuously.

It was not until the first openhearth (acid) steel furnaces were brought into production in 1869-1870 that the potential for refractories assumed major proportions. The acid openhearth spurred demand for silica brick, which was first produced in 1866, perhaps as early as 1858. But the first plant devoted exclusively to silica brick manufacture did not get into production until 1899.

Meanwhile, the basic openhearth, destined to consume prodigious quantities of silica, magnesite, and other refractory materials, became a permanent fixture in the steel industry in 1888 when Carnegie, Phipps & Co., started the first commercially successful furnace at Homestead, Pa. (now Homestead

Bettman Archive



HAND CHARGING a blast furnace (1873) when fire brick production topped 60 million units.

National Carbon Co.



CARBON LINING was installed in a blast furnace in America for the first time in 1945.

Works of U. S. Steel Corp.). Otis Steel Co., operated a basic furnace in Ohio two years earlier but it was not a commercial success. By 1890, 16 basic openhearths were in use.

Magnesite linings used in these early openhearths depended on imports from Austria, Hungary and Greece. Magnesite brick manufacture in the U. S. was not started until 1894 when a plant was built at Layton, Pa. Domestic magnesite entered the picture during World War I when the British blockade halted all imports and forced a country-wide search for American deposits. A major deposit was found in Chewelah, Wash., enabling the steel industry to maintain operations. The first domestic magnesite refractories plant was built about 1920.

Other landmarks in the industry's history include: 1893, bauxite brick manufactured at Pittsburgh; 1896, chrome brick made in Pittsburgh; 1913, metal-encased basic brick produced; 1914, plastic fire brick made its commercial debut; 1928, chemically-bonded basic brick produced; 1928, castables introduced; 1930, first commercial production of super-duty fireclay brick; 1940, super-duty silica brick introduced. High temperature cement was first sold in the late 1920's.

Industry begins mechanization

Another major development in the industry came about 1918-1920 with the manufacture of high alumina brick from Missouri diaspore. Diaspore had been found earlier in conjuction with other clays but its value as a refractory material had not been recognized and it was discarded as waste. But the supply was limited, and because of this industry began switching back to high-alumina brick made from bauxite in 1948.

After a slow start, the industry recognized the value of mechanization and adopted it with enthusiasm. In the process it had to overcome a general belief that hand-molded and hand repressed brick gave better service than those produced mechanically. Mechanization from raw material to finished product is now common. A modern refractories plant is largely controlled and operated automatically; the back-breaking labor and the dust-laden atmosphere of the old days are all but forgotten.

More than 90 pct of refractory brick now is produced on the power press, hydraulic press, vibrating press, or by extrusion; raw materials are mined, crushed, and compounded mechanically; tempering and drying floors are giving way to tunnel dryers; steel molds have largely supplanted wood molds; the continuous tunnel kiln has replaced the old periodic kiln to a considerable extent; dust-producing equipment is enclosed, and exhaust fans remove contaminated air from the plant atmosphere.

The industry was quick to appreciate the need and urgency of research. In the beginning quality control depended largely on the know-how and practiced eye of experienced workmen; new mixes were developed by trial and error. But a scientific approach was in the making before the last quarter of the 19th Century. It was spurred by consuming industries.

Analyses records were being maintained in the 1870's. Engineers were dispatched to Europe to observe foreign methods. At first, independent laboratories did research work for the producers, but in 1909 a large company constructed a laboratory devoted exclusively to research and control. Before the turn of the century, the Seger-Orton "Pyrometric Cones" were in use as a measure of the effects of time and temperature.

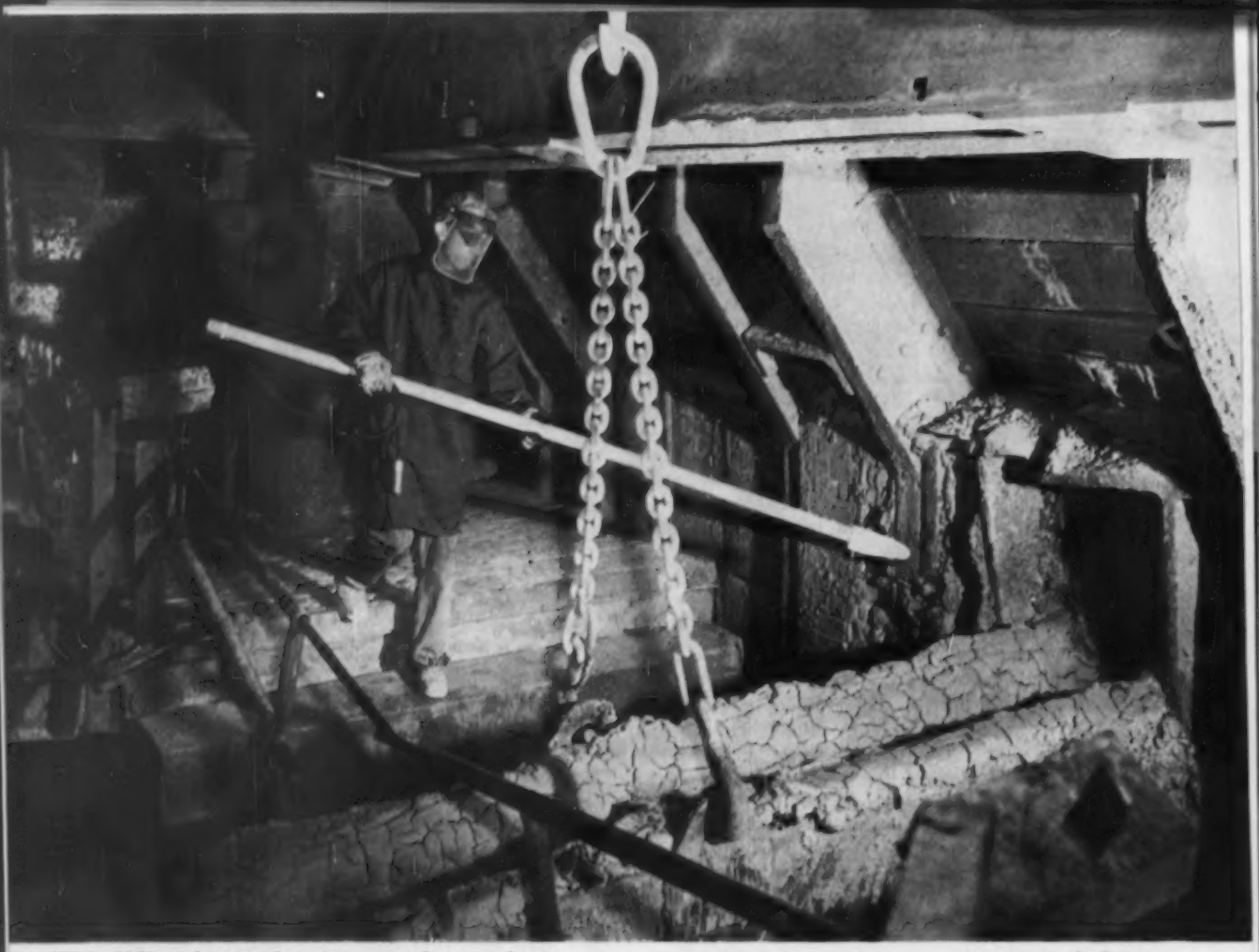
During the last century, refractories have made innumerable contributions to the industries they serve, notably in metals producing and fabricating. As an example, silica brick revolutionized the design of coke ovens and made possible the modern, efficient, chemical-recovery ovens of today. Openhearths, blast furnaces, electric furnaces, heating furnaces, heat-treating furnaces; high temperature operations of all types—all received a helping hand from refractories.

Carbon blocks—actually the butt ends of the then popular square electrodes—were used as long ago as the turn of the century in arc furnaces producing carbides. Some 60 years ago carbon linings were put in German blast furnaces and later widely used there. But it was not until 1945 that they saw any major use in the United States. Since then the hearths of more than 40 pct of all U. S. blast furnaces have been lined with carbon blocks.

Crucible Steel Co. of America



CRUCIBLE MELTING (about 1900) has been replaced by electric furnaces in the steel industry.



JET TAPPER makes openhearth tapping faster, safer. Du Pont

REFRACTORIES AND CERAMICS...

SUSPENDED ROOF of insulating firebrick is installed in a rotary hearth furnace. Babcock & Wilcox Co.





REFRACTORIES and metals have been prodding one another for over 130 years. Neither industry would want it any other way. While not without its headaches, the long-time relationship has meant progress for both.

In themselves, and without considering new or expanded facilities, refractories have added substantially to steelmaking capacity in the United States since the end of World War II. This has come through improved bricklaying methods, rammed bottoms and new higher-temperature refractories.

Current refractory technology in openhearth steelmaking includes:

1. High purity silica brick for roofs. From a temperature-resistant standpoint, super-duty silica will maintain its strength at temperatures 100°F higher than conventional silica of two decades ago. Today's conventional silica is 50°F better than earlier conventional silica. These improved silica refractories have meant a 20 to 40 pct increase in openhearth roof life.

2. New monolithic ramming materials for furnace bottoms. Bottoms are now installed in several days against several weeks for a burned-in bottom of grain magnesite mixed with slag. Damage to other refractories, a problem when installing a burned-in bottom, is eliminated. A recent development is a high-purity, high-strength magnesia ramming mixture for openhearth bottoms.

3. Progress in sizing of dead-burned magnesite grains permits reduction in basic slag requirements, provides maximum density.

4. Development of special monolithic magnesia-base mixes for maintenance patching.

5. Metal-encased and chemically bonded magnesite-chrome brick for front walls, back walls, and end walls.

6. Improved silica mortars of equal refractoriness with best quality silica brick.

Although initial cost is high, basic brick has paid off in terms of ability to withstand faster openhearth operating rates with less downtime for major repairs and temporary hot patching. A challenge to refractories producers is the basic openhearth roof. Economy is still in doubt. At Keystone Steel & Wire Co., where an all-basic, flat, suspended roof was installed in July 1954, A. H. Sommer, vice-president and general superintendent, feels that "this type of construction may be practical in spite of higher initial costs." U. S. Steel Corp. has been experimenting with an all-basic roof at South Chicago for several years.

The so-called zebra rear roof shoulder is another comparatively recent development. Composed of alternate sections of basic and silica, the zebra roof has extended time to the first roof patch by approximately 50 pct at some plants. Some operators use it when they are pressing for higher production, return to all-silica when business is slow.

In the blast furnace, better and more versatile refractories have solved the problem of carbon monoxide disintegration and increased output per lining. There has been a decided improvement in blast furnace stove refractories to cope with the trend toward higher operating temperatures. Castable refractories promise to simplify lining of blast furnace mains.

Carbon linings are doing a good job in blast furnace hearth walls and the bottom adjacent to the hearth. The carbon lining has brought smoother furnace operation and minimized danger of breakouts. There are over 110 linings in U. S. furnaces. Several have produced over 3 million tons before being blown out.

In the foundry field, success of carbon linings in the trough led to its use for the tap block in the cupola breast. Carbon block well linings have been installed in foundry cupolas. Other metallurgical refractory uses of carbon include notches, mold plugs and stool inserts.

Furnace temperatures, both melting and heating, are on the upgrade. A butt welding furnace will reach 3000°F in the hottest zone. Yet a relatively new type fused mullite brick (melting point 3335°F) stands up for a year in this service. It is used in bungs, burner blocks, uptake arches and sidewalls, crossovers and furnace sidewalls.

New materials emerge

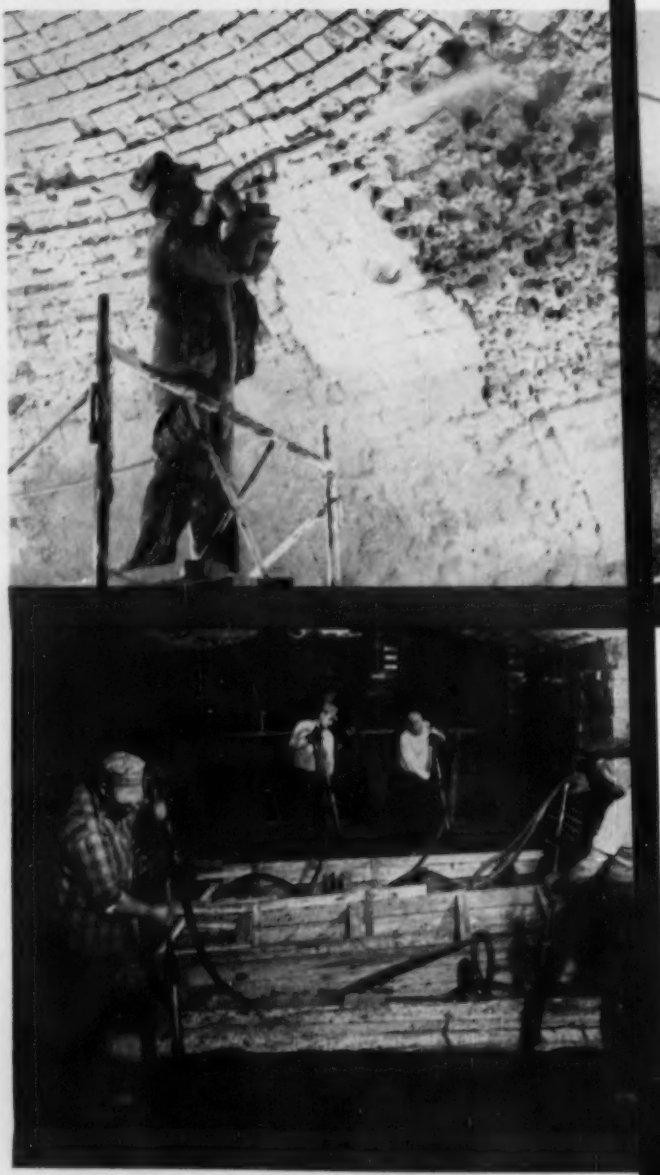
A new magnesite-chrome refractory, electrically melted and cast, has shown up well in openhearth and electric furnaces. Several users are getting as many as a third more heats per campaign where panels of this material were installed in vulnerable areas.

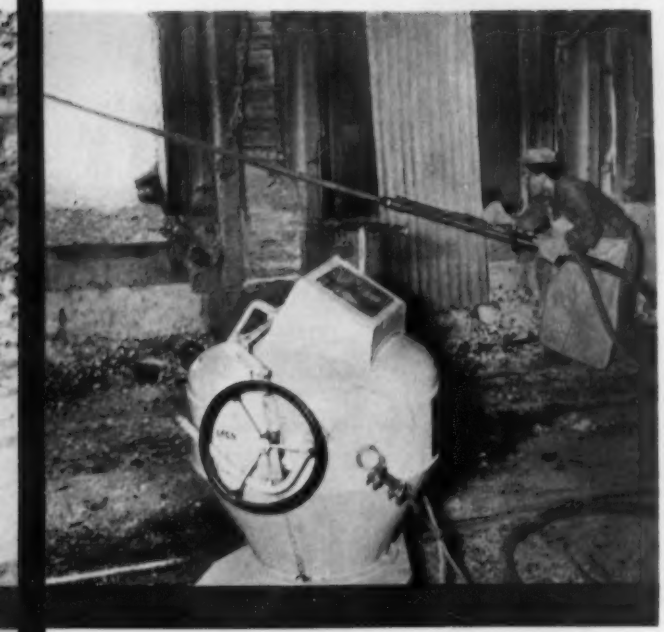
Stabilized zirconia is now available in various forms including bricks, shapes and mixes. With its high melting point (4700°F), excellent resistance to thermal shock and very low thermal conductivity, it is a postwar development of considerable promise.

Lightweight insulating firebrick shows savings in heat treating and nonferrous melting furnaces. Because of their light weight they store relatively little heat. This permits use of less fuel, close temperature control and faster heating. In a typical stress relieving furnace with a volume of 2200 cu ft, temperatures are held within 5°F.

Important in steel processing are high duty and alumina brick which were not available 30 or 40 years ago. Metal-encased and chemically-bonded magnesite-chrome brick are advantageous in soaking pits. But a trend is also developing toward high alumina brick for soaking pits.

Newcomer on the refractories scene is a superquality semisilica fireclay brick that may be used in a soaking heat to 2700°F, or 100 to 150°F better than regular semisilica. It is highly resistant to fluxing by alkali slags and fume, has improved load-bearing ability at high tem-



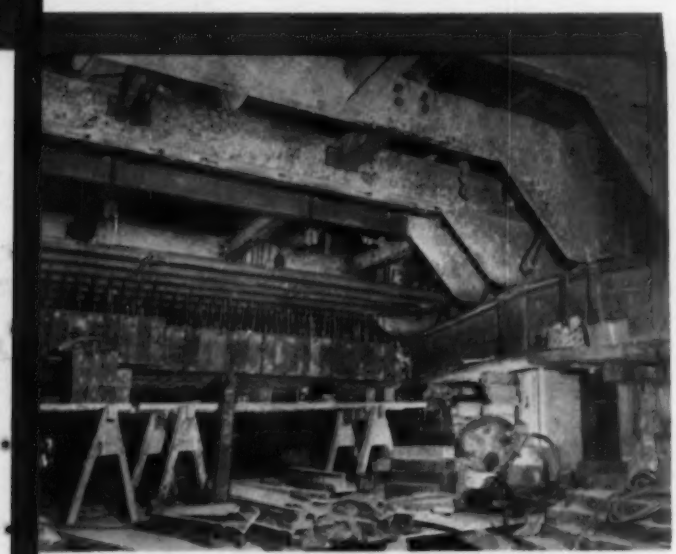


1 HIGH ALUMINA CASTABLE is quickly applied to furnace roof with a special gun.

2 RAMMING OPENHEARTH bottom. Process cuts days off installation time, avoids wall damage.

3 PNEUMATIC refractory gun throws patch onto back skewback of large openhearth furnace.

4 ALL BASIC flat suspended openhearth roof during installation. Brick costs more, lasts longer.



peratures under severe operating conditions.

Refractory concrete is now available for service up to 3200°F. Only a short time ago, concrete for 3000° service was a problem case. The new castable has an alumin-silica base, is designed for the 2600-3200°F range.

Plastics and castables are adaptable to good engineering design, with little regard to dimensions, curvatures or slopes and are resistant to spalling. Elimination of joints reduces air and gas leakage and heat loss.

Applications vary widely

Applications include soaking pit covers, side and end walls; rolling mill furnace walls and roofs in the hot and soaking zones; checker sidewalls and roofs, fan tails, and noses in open-hearth furnaces; blast furnaces, forge furnaces, welding furnaces, rivet furnaces, spike furnaces, annealing ovens, normalizing furnaces, and brass foundry converters.

New techniques and frits have greatly expanded applications of porcelain enamel in industry. These new ceramic coatings received intensive development for jet engines.

Today they are moving throughout industry. They will outlast uncoated steel parts from two to five times at temperatures to 2100°F; below 1500°F they will prolong steel part life almost indefinitely. They permit use of thinner gages, reduction in alloy content, can easily be machined, have resisted flash heating at 2800°F for 5 min. Some will take repeated quenchings in water from 1600-1700°F, can be cold bent through 90° with only a slight powdering of the ceramic.

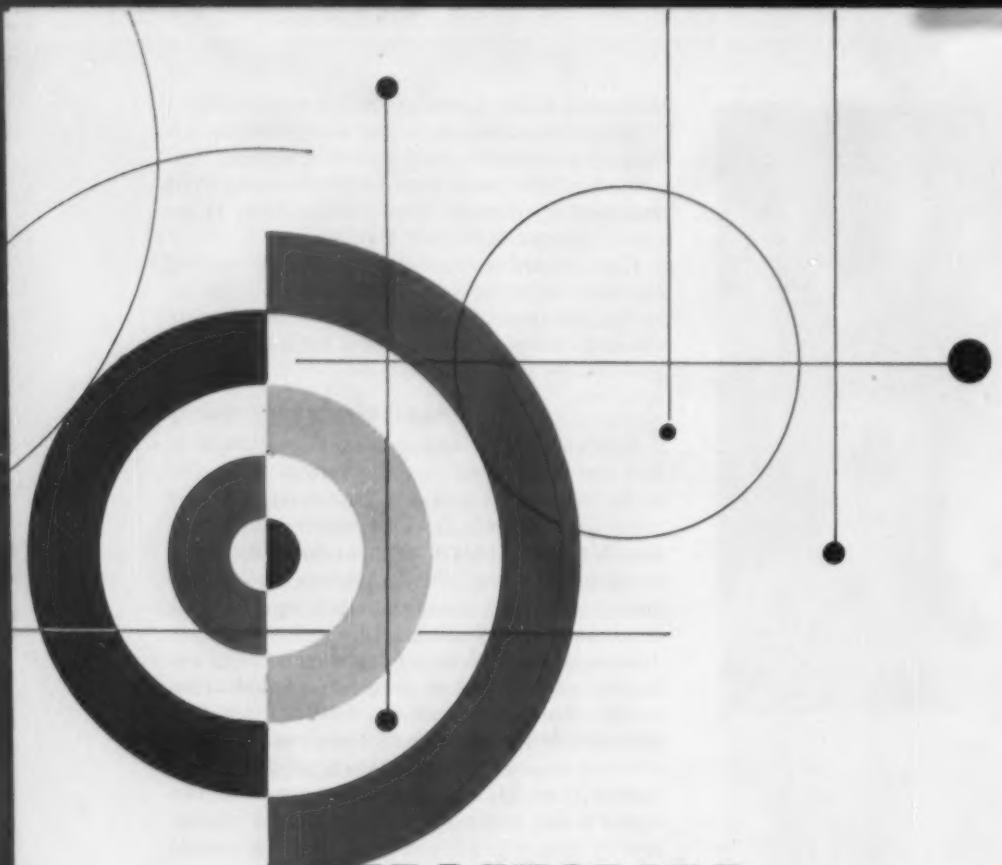
Pump housings, heat exchangers, coal chutes, furnace tools, conveyor buckets are a few of the good industrial applications.

Cermets (ceramic-metal mixtures) are another interesting high temperature possibility. Carbides, oxides, alumina, titanium and beryllium are now being investigated. Unlike porcelain enamel ceramics, these are formed hydrostatically or by hot pressing. They may be mechanical mixtures, interfacial spinel or solid solution products.

Wear resistance, general high temperature behavior and strength-to-weight ratio of cermets is good; ductility is not yet too good and cost is high. But they will probably see service in rockets, thermocouple tubes, induction heating coils and electronic cathodes.

ACKNOWLEDGMENT

In addition to those mentioned in the text or in photo credits, the editors want to thank the following for their help in preparing this section: Aluminum Company of America, A. P. Green Fire Brick Co., Cement Gun Co., Corhart Refractories Inc., Kaiser Aluminum & Chemical Corp., Laclede-Christy Co., National Carbon Co., National Steel Corp., North American Refractories Co., The Ramtite Co., The Refractories Institute, Sharon Steel Corp., and Zirconium Corporation of America.



REFRACTORIES

the future

REFRACTORY makers will continue the trend toward higher operating temperatures. Without additional capital outlay this will expand steelmaking capacity. Ability of all type of furnace refractories to operate at higher temperatures and stay in service longer will tend to offset rising labor costs throughout all industry.

Interest in basic lined cupolas will grow. They increase lining life, give higher manganese recovery and permit the lower sulfur particularly desirable on ductile iron. The future of the all-basic openhearth is one of economics; rising installation costs may lower its present 4 to 1 installed cost ratio over silica.

Silicon carbide may move from present skid rail, duct and flue lining uses to blast furnace dust catchers and stack linings, fuel bin throats and other abrasive applications. Stabilized zirconia and chrome magnesite applications will widen, too.

Castable and plastic refractories use, now about 2 pct of total output, will grow rapidly. It should soon be possible to shoot plastics from guns. Constantly rising labor costs are a key: First cost is higher but they usually cost less to install. As equipment costs rise, downtime becomes more expensive, speedy repairs more important. but they are no cure-all, don't compete with large-tonnage brick installations.

Blast furnaces with carbon hearths now account for more than half U. S. pig iron output. Eventually most of U. S. blast furnaces will have carbon hearths, some will take carbon to the mantle. Foundry cupola use of carbon will increase. Cupolas with a carbon lining in the well and a water-cooled, unlined melt zone have shown little or no lining wear during operation. The carbon does oxidize when the bottom is dropped but there are several ways to get around this.

Porcelain enamel use in industry will grow very fast. Though tonnages are not large, its ability to resist heat, corrosion and abrasion will help wide sections of industry. With home and architectural applications its volume should be close to $500 million annually in 5 years, or a $300 million gain over the pre-World War II level. Its industrial future is just starting.



Dead-burned dolomite and special granular basic refractories are manufactured at the Maple Grove, Ohio Works.



At Gabbs, Nevada, four distinct types of magnesia granules are produced—each designed to serve a specific application.

THIS IS BASIC REFRACTORIES, INCORPORATED



Basic employs skilled personnel—men with practical steel-making experience—to insure that the use of its products gives full value. Here for example, supervision is being provided on a RAMSET hearth installation.

• Until 1914 the American Steel Industry relied on "dead-burned magnesite" from Austria and domestic unprocessed dolomite for the construction and maintenance of basic furnace hearths. Then, to meet war shortages of magnesite, the manufacture of dolomite into a scientifically prepared refractory was begun by three companies. These consolidated at a later date to form Basic Refractories, Incorporated.

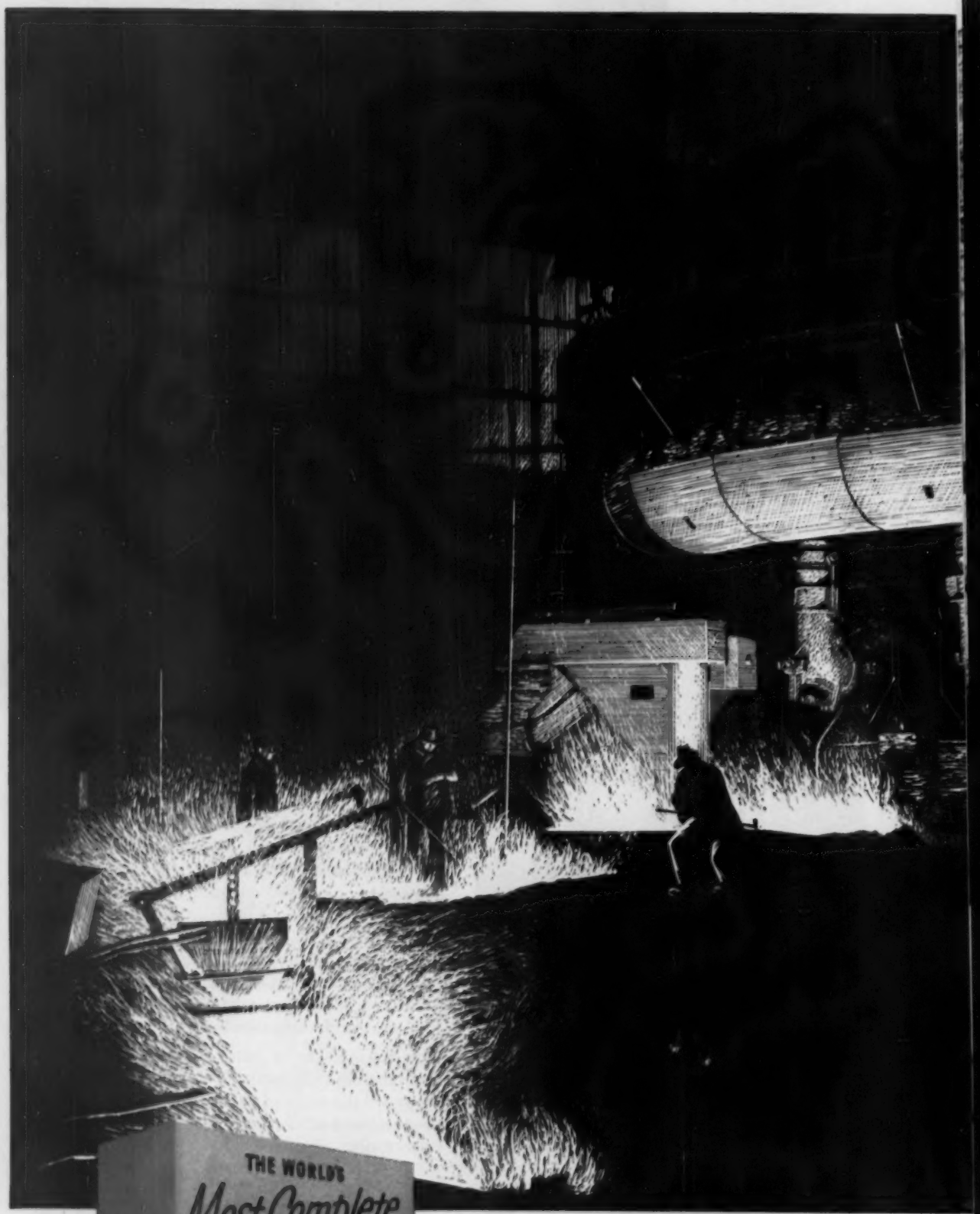
Over the intervening years, retaining the leadership inherent in its early efforts, the company has expanded the scope of its activities to include the production of a full complement of granular basic refractories.

BASIC REFRACTORIES INCORPORATED

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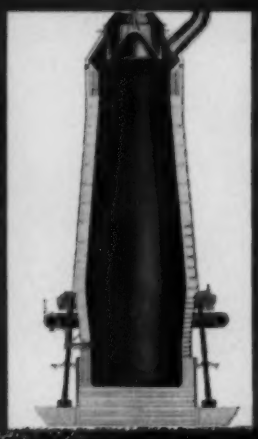
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BLAST FURNACE REFRACTORIES

specialized types
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for every furnace requirement



The railroads were still pushing back the frontiers of America when Harbison-Walker manufactured its first blast furnace lining. During the years which have followed, the company has made the majority of all the blast furnace refractories used in the United States. Today there are more Harbison-Walker linings in service than all others.

The high standing of Harbison-Walker blast furnace refractories has been maintained through continuous product research and the continuous development of more precise methods of manufacture. Progress in blast furnace operation has demanded superior performance from refractories and Harbison-Walker refractories have kept abreast.

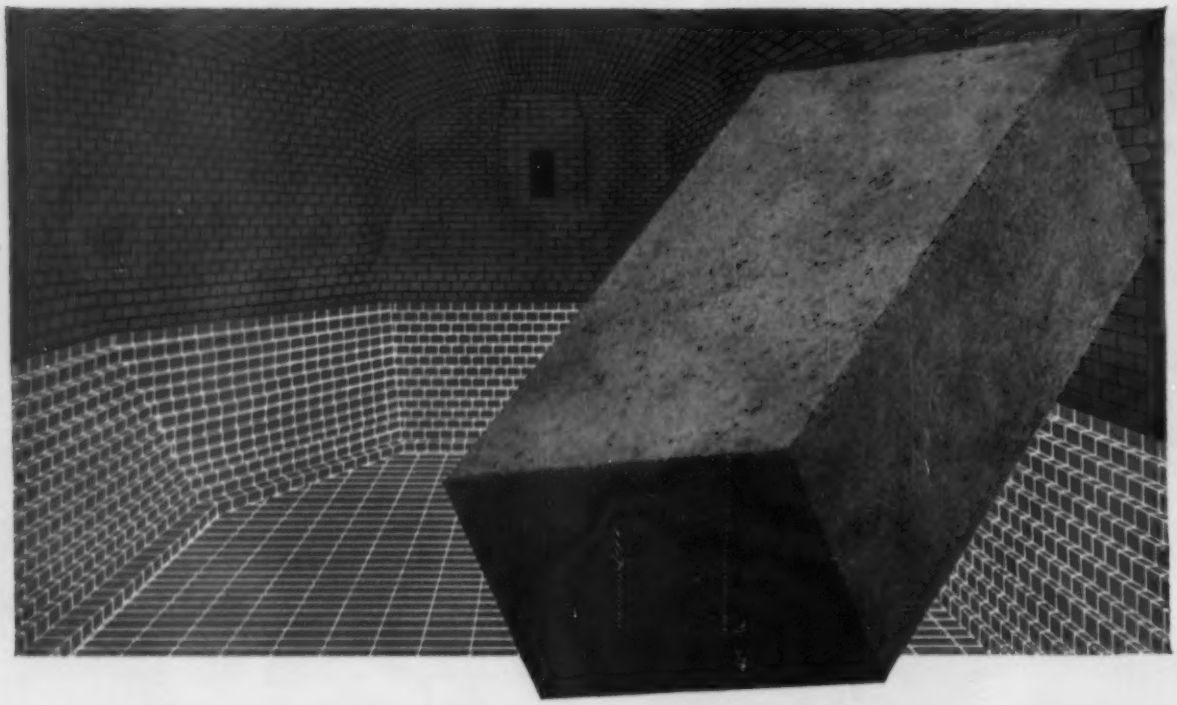
You are invited to consult Harbison-Walker regarding any of your refractories problems. The value of the company's recommendations is based upon its wide experience, its technical staff and its service records.

REFRACTORIES COMPANY

World's Largest Producer of Refractories • *General Offices: Pittsburgh 22, Pennsylvania*

June, 1955

J-11



GET EXTRA SUB-HEARTH SAFETY WITH PERMANENTE PERICLASE D-S BRICK!

MAJOR STEEL COMPANY ceramists have found that Permanente Periclase D-S Brick meets their requirements for the safest, most efficient sub-hearth refractory.

This superior brick is being used in open hearths of leading steel producers because it gives *maximum protection against costly breakthroughs, gives longer sub-hearth life.*

Permanente Periclase D-S Brick has been *designed especially* to withstand conditions that exist in the sub-hearth and up to the slag line. It is made from pre-shrunk, accurately-sized Periclase grains derived from sea-water magnesia and has all the properties outlined by ceramists as most desirable.

Among these properties are:

High MgO—Contains more than 95% MgO (165 pounds of MgO per cubic foot of brick).

Chrome-free—Eliminates the reduction of chromium oxide when sub-hearth brick is in contact with molten pig iron or high carbon steel. Under these conditions, chromium would be absorbed by the bath with resultant damage to the refractory structure. Carbon monoxide generated during a heat penetrates to the sub-hearth and also reduces chromium oxide in chromite-bearing brick. (Brick contains only 0.8% Cr_2O_3).

Low iron oxide—Minimizes the effect of alternate oxidation and reduction of iron oxide and other iron compounds which can cause damage to refractory brick. (Brick contains only 0.6% Fe_2O_3).

Low calcium oxide—No refractory damage caused by slaking during a slow heat-up or while the furnace is idle. (Brick contains only 1.2% CaO).

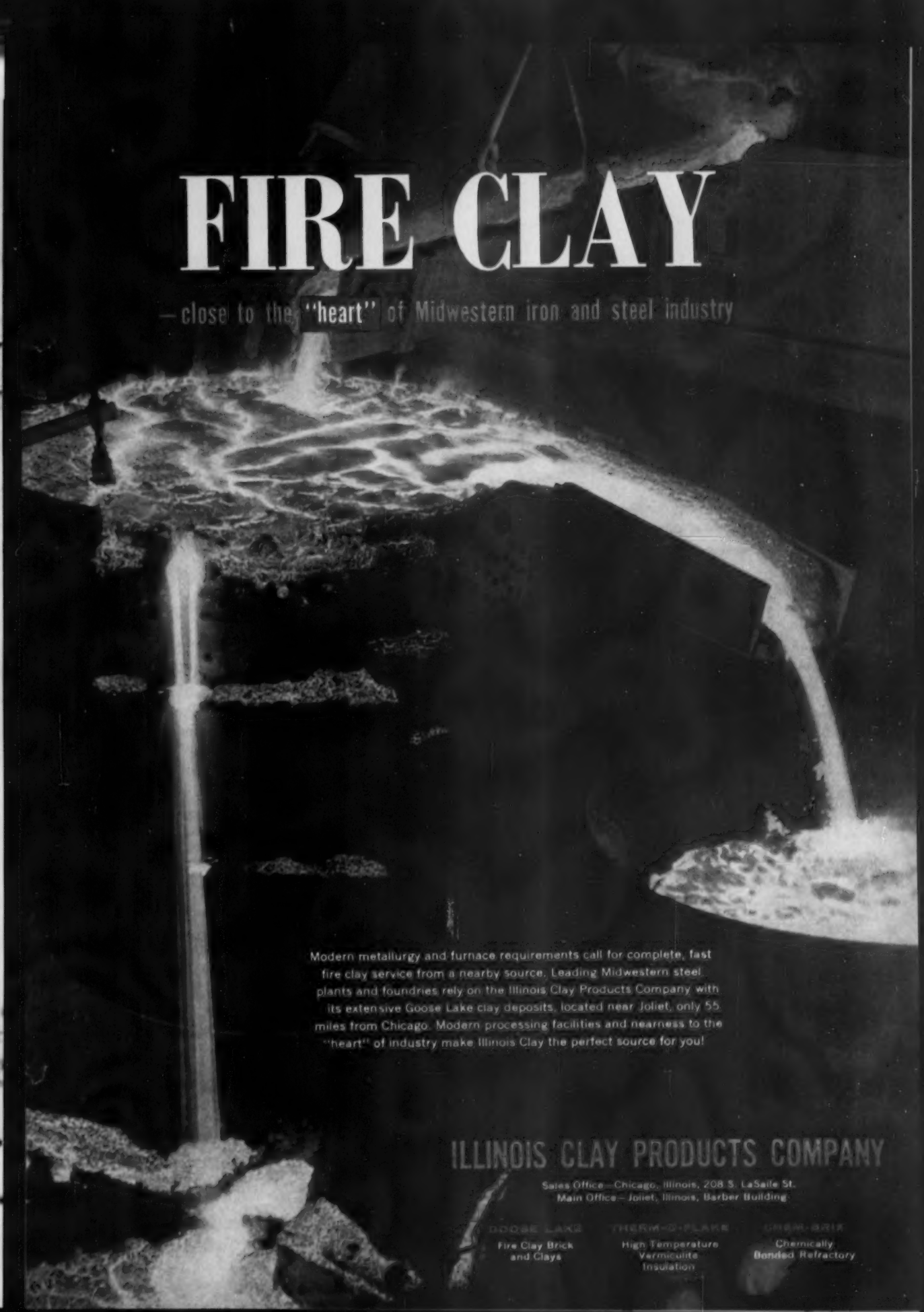
With all its many advantages, Permanente Periclase D-S Brick gives you the ultimate in sub-hearth safety and durability—yet costs no more.

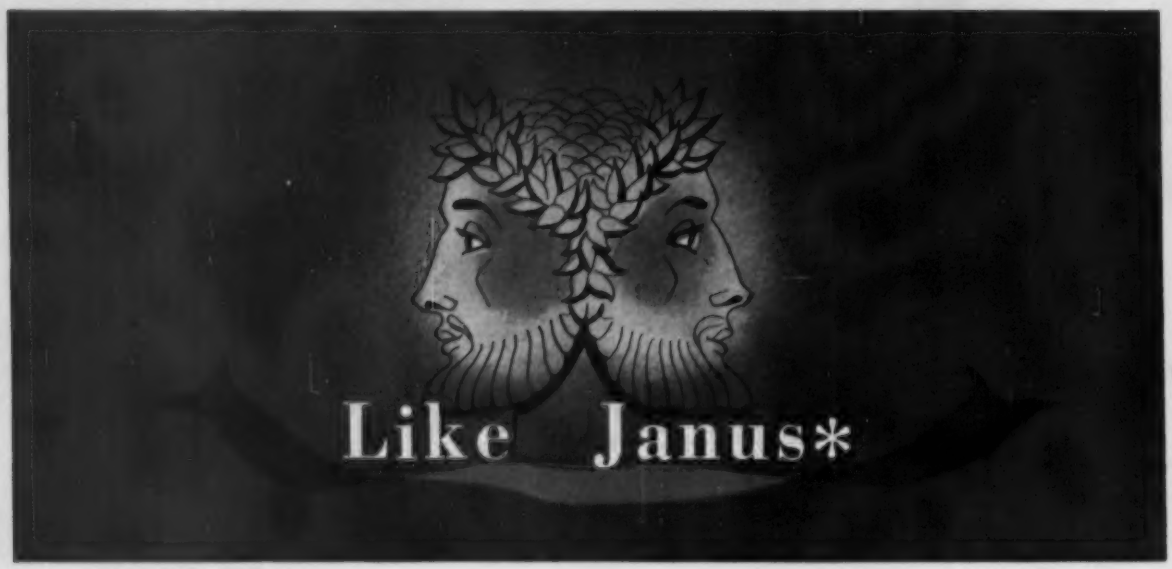
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looks back with pride . . . and forward with confidence

Reviewing the past, The J. E. Baker Company is proud of the part it has played in the astounding growth of the steel industry. Since 1889 the JEBCO name has stood for superior products. One of these products, BAKER'S MAGDOLITE the *original* dead-burned dolomite, was the result of continuous research and experimentation to find a far better basic lining for open hearth and electric furnaces. Today as in the past, BAKER'S MAGDOLITE offers increased furnace efficiency at lower refractory costs.

In the future, users of BAKER'S MAGDOLITE can be assured of constantly improved quality and effectiveness, in keeping with the tremendous strides foreseen in increased steel production.

If you haven't done so in the past, be sure to try BAKER'S MAGDOLITE in the near future. You'll discover as others have through the years that the properly burned, grain-sized particles of BAKER'S MAGDOLITE mean more uniform ingots, in greater numbers and with less defective material. Next time specify BAKER'S MAGDOLITE.

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SINCE 1889

*Janus, the two-faced mythological Roman God of Doors and Gates, could see both what passed behind and before him at the same time.

THE J. E. BAKER COMPANY

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GENERAL REFRACTORIES

FILET MIGNON—a la BRICK Sizzling, savory, juicy—dripping with butter—dashed with Worcestershire—and all of it brought to your table because of brick—refractory brick.

Refractories that contain the flames of industry. That produce the steel for your stove, your cabinets, your cooking utensils . . . provide the heat for the oven, the cold for the refrigerator . . . make rails, cars and engines which bring your steak to town; the wheels, body and motor of the truck which delivered it to the butcher. The platter on which it is served. The knife to cut it. The fork to eat it. The lights for the table. All—born of refractories.

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Developing them, producing them, applying research to their improvement, drawing on resources all over the world, is the complete refractories service that we provide to industry, everywhere.

GENERAL REFRACTORIES COMPANY
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A COMPLETE REFRACTORY SERVICE



OLIVE HILL— The world's most renowned blast furnace brick (it is a strong and dense fireclay product)—with superior resistance to slag, load, abrasion, carbon disintegration, and alkali attack.



RITEX— Unburned basic brick—in magnesite, magnesite-chrome, and chrome-magnesite. More resistant to spalling. Lower porosity, lower thermal conductivity —high hot strength.



STEELKLAD— A Ritex basic brick, permanently jacketed in a patented steel shell. Just one of many superior GREFCO products.

(Advertisement)

What it takes to make a 3000 Degree Refractory Concrete



Because of the widespread interest in the use of refractory castables, many furnace operators have asked us for the story behind the performance of B&W's unique refractory concrete, Kaocast.

Here are the answers to some of the most frequently asked questions:

Q. *When you refer to Kaocast as a 3000 degree refractory castable, do you mean that its melting point is 3000° F?*

A. No, this means that its service use limit is 3000° F; its melting point is 200 degrees higher.

Q. *Just what does it take to make a 3000 degree refractory castable like B&W Kaocast?*

A. Let's first define a few terms. Refractory castables are made with granular materials which are volume stable at high temperatures and which can undergo repeated heating and cooling cycles without disintegration. These materials, known as refractory calcines or grogs, are blended with suitable hydraulic binders. The initial strength of a refractory castable is thus developed in the same manner as that of ordinary concrete—that is, through the chemical action between water and the binder. A strong *ceramic bond* is formed when the refractory castable is subjected to temperatures above the vitrification point.

Q. *Then you have a grog, a binder and a method of putting them together. Which is most important?*

A. You can't say that any *one* is most important. It's a combination of all three. Let's take them one at a time. Our grog consists primarily of the proper blend of kaolin and other alumina-silica materials. This ratio enables us to achieve a grog with minimum expansion and shrinkage, a high fusion point, and greater stability under load, at varying temperatures.

Q. *And now, what about the binder?*

A. There are a number of factors responsible for the success of the Kaocast binder. One is the compound Tricalcium Penta-aluminate (3 lime to 5 alumina). This formula produces the most refractory compound (highest melting point) that can be made from lime and alumina. Another is that by using the purest commercially available lime and alumina, the Kaocast binder is substantially free of iron and silica. Such traces of these that are present combine during the prefiring of the binder to produce stable compounds.

Q. *Just how important is the manufacturing or "blending" of the grog and the binder?*

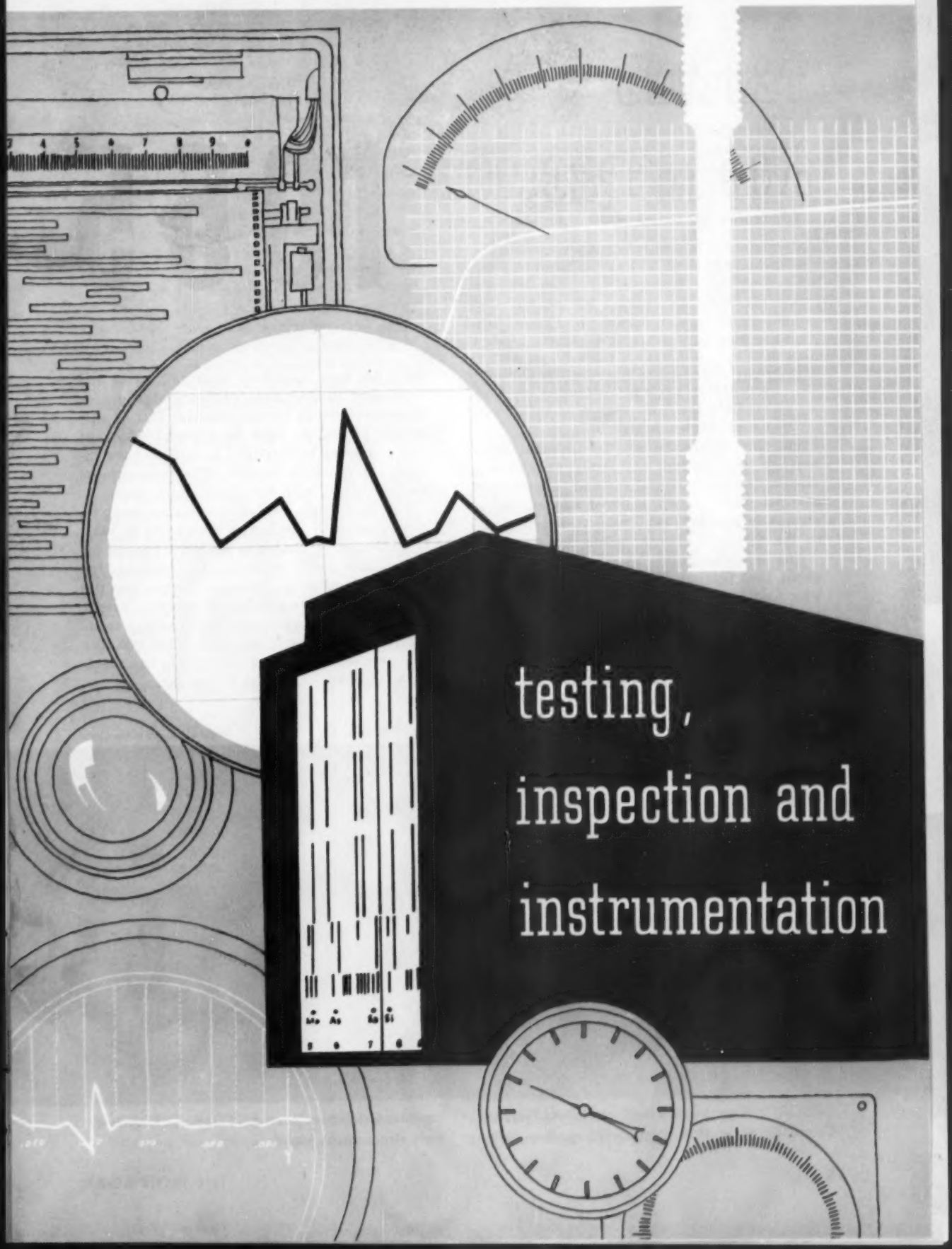
A. If one factor could be singled out as "most important" it would be quality control.

Direct control over the fineness of materials, prefiring temperatures, and other phases of manufacture is possible at B&W because both the grog and the binder are made and blended at B&W's Augusta Works—under B&W's direct control and supervision.

Q. *These factors you've discussed must add up to some specific advantages of Kaocast. What are they?*

A. B&W Kaocast has all the advantages of easy installation which are responsible for the widespread interest in refractory concretes, plus these exclusive features: It is the only 3000 degree refractory concrete with high resistance to spalling and low volume change throughout its operating range.

THE BABCOCK & WILCOX CO.
Refractories Division
General Offices:
161 East 42nd St., New York 17, N. Y.
Works: Augusta, Ga.



testing, inspection and instrumentation

TESTING AND INSPECTION 1855 1955

THE ABILITY to test, measure, duplicate and control parts and processes has made possible the high degree of industrialization known today.

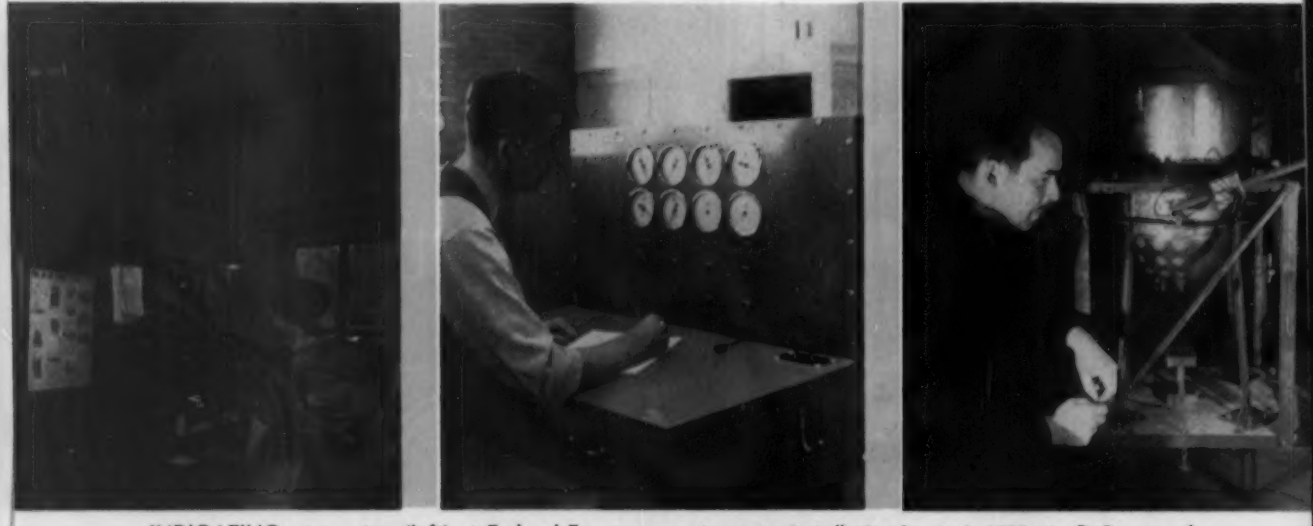
From the mid-1850's on, fundamental progress in the testing of parts, measurement standards, instrumentation and interchangeable manufacture was achieved and applied so vigorously that by 1900 American industry was on the threshold of mass production.

The interchangeable system had its origin about 1800 through the efforts of Eli Whitney who first made gun parts on an interchangeable basis using hardened templates as gages.

With these beginnings the use of jigs, gages and fixtures grew rapidly. While their earlier application was mostly in gun makers' plants, their use soon spread to other industries and from 1830 to 1850 had reached a high degree of development in watch factories. During this period Elisha K. Root as superintendent of Colt's Armory in Hartford is said to have installed a complete system of interchangeable manufacturing with jigs, fixtures and gages.

The first truly precise measuring machine was invented by Sir Joseph Whitworth in 1851. Later Joseph R. Brown of Brown & Sharpe invented and built an automatic machine for graduating rules in America. Soon after the development of the graduating machine Brown brought out the vernier caliper capable of reading to thousandths of an inch. This was the first practical measuring tool within the reach of the ordinary machinist of the day.

The Bristol Co. Baird Associates, Inc. Baldwin-Lima-Hamilton Corp.



INDICATING pyrometers (left) at Federal Furnace Co., Chicago in 1909. First direct reading spectrometer installation (center), 1939. A. C. Ruge and early strain gages (right).

Other advances made by Brown in the art of precision measurement were the standard wire gage in 1857, the micrometer caliper in 1867 and the pocket sheet metal gage in 1868.

In the late 1870's lack of agreement of standard measurements and the growing demand for interchangeable bolts and nuts led Pratt & Whitney Co. to seek after a set of gages upon which all could agree. The basic problem again was one of standard measurement. The famous Rogers-Bond comparator capable of correct measurements within one fifty-thousandths was one result of these efforts.

The first set of accurate gage blocks were made by Johannsen of Sweden in 1896.

While interchangeable manufacture grew rapidly from Eli Whitney's time until World War I, it was carried out for the most part on an individual plant basis and within the range of measuring standards for that plant. Thousands of parts served as masters by which production gages were calibrated and checked. This procedure was cumbersome, wasteful, inefficient.

World War I brought on an abrupt change. Since individual plants could not efficiently produce entire units, subcontracting of components became necessary. Realizing the need for universal standards of measurement the National Bureau of Standards undertook the task of calibrating all master gages used in the manufacture of ordnance items. It was a major step in advancing gaging procedures.

At the end of World War I, dial indicator gages began to gain wider acceptance and to play a gradually increasing part in production and inspection gaging. They also paved the way later for instruments which were considered laboratory devices, used mainly in final inspection gaging. Indicator, hole, and snap gages were among the many gage developments at this time.

In 1919 Jones & Lamson Machine Co. developed the optical comparator for checking screw threads rather than relying on feel alone with a ring gage.

From the 1920's on, mass production increased rapidly and along with it the improved gages and measuring instruments to make it possible.

Gage ammo for actual size

Dial indicators and dial indicator gages were developed and first used in the watch industry. Their use gradually increased throughout the 1930's and became general during World War II and later during Korea to the point that they became a generally accepted means of gaging.

The chief reason for this was that they replaced the sense of feel required of fixed gages with the faster and more positive advantage of determining how much a dimension varied from the one specified.

During World War II indicating or instrument gages were introduced for single or simultaneous gaging of limiting dimensions and dimensions of form or position.

They could inspect singly or in combination external or internal dimensions, location, concentricity, squareness, flatness or parallelism. Multiple gages now applied to a wide variety of parts were first used to inspect ammunition for actual size rather undersize or oversize which had been done formerly.

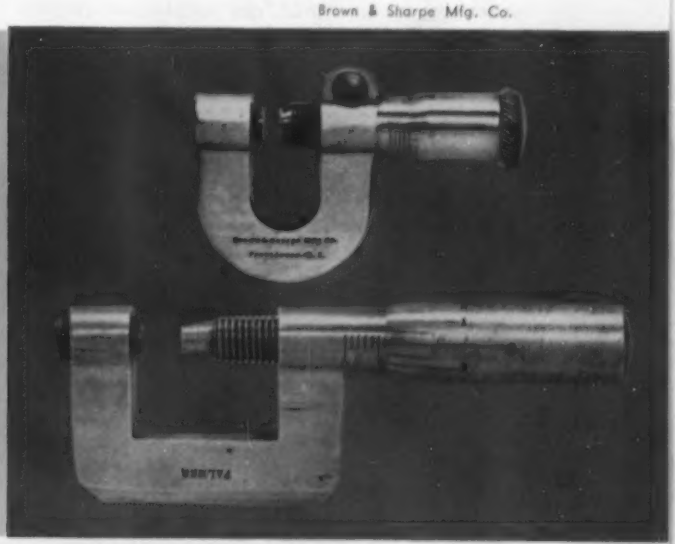
These instrument gages of the air, electronic and electric types are now in advanced stages

The Sheffield Corp.



AIR GAGES about 1940 were used for checking the bore and rifling of gun barrels.

Brown & Sharpe Mfg. Co.



POCKET sheet metal gage (top) was developed in 1868 and Palmer micrometer (bottom) in 1867.

of development. Applications of air gaging before World War II include their use by Western Electric Co. for inspecting the flatness of discs for telephone receivers.

Metallographic testing, now so fundamental a part of all metals inspection, was first started by Henry Clifton Sorby in 1863 when he began research on the application of the microscope to metallurgy.

The first practical use of metallography was made in the early 1900's by Albert Saveur at the Illinois Steel Co. He later became the first practical consulting metallographist in America when he opened the Boston Testing Laboratories in 1901.

Although Mohs devised the first method of hardness measurement in the 1800's, the first practical hardness testing machine was made by John August Brinell of Sweden about 1900.

Shortly after the introduction of the Brinell hardness tester, the scelerescope method of testing was devised by Shore and Breuil. Following these advances was the well-known Rockwell hardness testing machine which has enjoyed wide use.

In the early 1900's various so-called "scratch" methods were devised to measure abrasive hardness. Among the first scratch hardness tests were Martin's diamond test and Turner's scelerometer. The Charpy impact machine originated by the Frenchman Georges Charpy came into being in this era.

Test cannon metals

One of the earliest American tensile testing machines was designed about 1850 by Major W. Wade for testing cast iron and bronze for cannons. Test records on the machine show no loads above 45,000 lb.

One of the largest and most precise testing machines in the world was installed at Watertown Arsenal in 1879. Designed by A. H. Emery the machine has a capacity of 800,000 lb in tension and 1,000,000 lb in compression. The famous Emery machine has two outstanding features. They are: the use of a hydraulic support and the use of flexure plates instead of knife edges throughout the entire mechanism.

The earliest record of a dial indicator used on a testing machine is attributed to an Englishman Thomas Dunn in 1865. A few years later Riehle Bros. applied a dial indicating gage to one of its machines for the first time. From the 1870's to the present, Riehle Bros. and Tinius Olsen developed a wide variety of testing machines of many types.

About the turn of the century a very important development in the testing machine field took place when Amsler introduced the first pendulum dynamometer for measuring and indicating the load of a specimen in 1904.

The resistance wire strain gage was thought of almost simultaneously about 16 years ago



Leeds & Northrup Co.

OPTICAL pyrometer was introduced in 1909 for checking temperatures in steel furnaces.

by Edwin Simmons at California Institute of Technology and A. C. Ruge at Massachusetts Institute of Technology. When first shown by Simmons at an ASTM impact symposium in 1938, it failed to arouse much curiosity. But since A. V. de Forest first measured frequency response with a wire strain gage up to 50,000 cps, it has steadily improved in value and use.

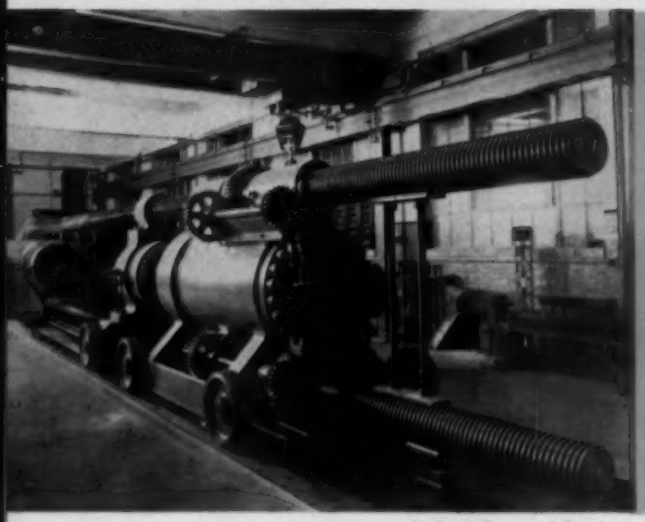
Nondestructive testing, one of the fastest growing areas of inspection and process control, is of fairly recent origin and covers a wide range of equipment and techniques. These include magnetic particle testing, penetrants and such dramatic devices as ultrasonic, electronic and radiographic testing machines.

Enter dye penetrants

About 1942 fluorescent penetrant test methods were first used primarily for testing nonmagnetic aircraft parts. They have since received wider application in those industries which use light metals and austenitic steels, superalloys and solid material such as ceramic insulators.

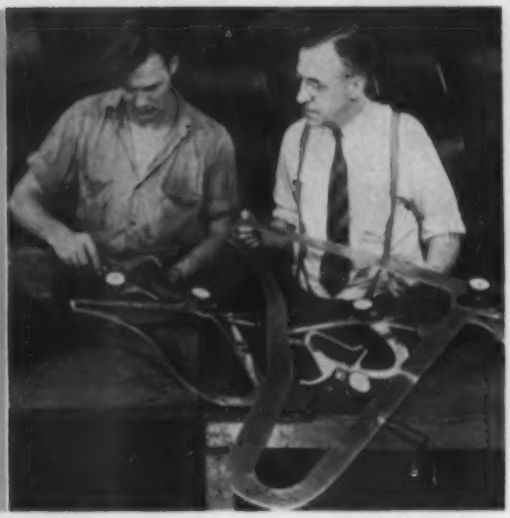
Dye penetrants introduced in the last 5 years are directly descendent from the oil and whiting test which has been used for the past 70 years. They are particularly desirable where portability is of importance and only certain areas of large objects need testing.

Magnetic particle testing was first offered to industry in the late 1920's. Until the middle '30's it was used with dry powders and portable magnetizing sources. A wet method using colored pastes and magnetizing equipment of the horizontal and tank type became standard during World War II. High volume automatic inspection units have characterized the advances in post-war magentic particle testing



National Bureau of Standards

HORIZONTAL Emery universal testing machine has 2.3 million lb capacity in compression.



Federal Products Corp.

INDICATING gage uses started growing in 1930's. Caliper type, above, checks pipe elbows.

along with extensive use of fluorescent magnetic particles.

Ultrasonic testing is a recent development starting in about 1945. It is usually classed in three types: the resonance, thru-way, pulsed echo or radar methods. They are mainly used for locating deep subsurface defects or near surface conditions not detectable by other methods.

Radiography is the oldest of the high-powered nondestructive tests. Most industrial x-ray units, radium sources and new artificial radioactive sources made available by the government are used in installations where a relatively few test castings or other critical parts are checked.

The term "x-ray" inspection historically refers to inspection by radiation where the source is a vacuum tube, usually of the Coolidge type. In its filmless fluoroscopic versions it is increasingly used for volume inspection for defects and for assembly or short fill errors.

The Betatron is a post-war development of a special source operating on a different principle than the Coolidge tube and having higher effective voltages and deeper penetration. In 1948, Allis-Chalmers made a striking demonstration by photographing an entire Army jeep in which a missing valve spring could be seen.

Instrumentation from the days when temperature devices were delicate, inaccurate and undependable to the present, precise and foolproof units have kept pace with progress in the metalworking industry.

Before the development of the rare metal thermocouple in the last half of the 19th century, temperatures in metalworking processes were measured mostly by means of crude eyesight comparisons or use of ceramic cones.

By the early 1890's recording thermometers of the thermostat type were in use for operations up to 800°F. Applications were mostly for recording temperatures in ovens, kilns and tanks. Practical electric pyrometers made their appearance in the metalworking industry between 1900 and 1910. The development that sparked this advance was the invention of the iron-constantan thermocouple.

Apply Wheatstone bridge

From 1910 to 1915 recorders and controlling instruments were developed for temperatures up to 2000°F. During this period the first potentiometer-type instrument employing the Wheatstone bridge principle came into commercial use. About 1918, a practical, disappearing filament type optical pyrometer was introduced.

Several systems of controlling furnace temperatures were in common use in the early 1900's usually employing electrical contacts from the galvanometer to activate air and gas valves. In the early 1920's greater accuracy was made possible when motor-operated valves were made to operate from the instruments. Many instruments were introduced during this period for checking and recording temperatures at several points in a single furnace or several furnaces by using several couples and only a single instrument.

By the mid-1920's radiation temperature instruments were made for measuring temperatures where the use of thermocouples was impractical. Other developments include the use of electronics in temperature instrumentation. Development of the vacuum tube greatly increased the value of these instruments through it's ability to amplify weak signals.



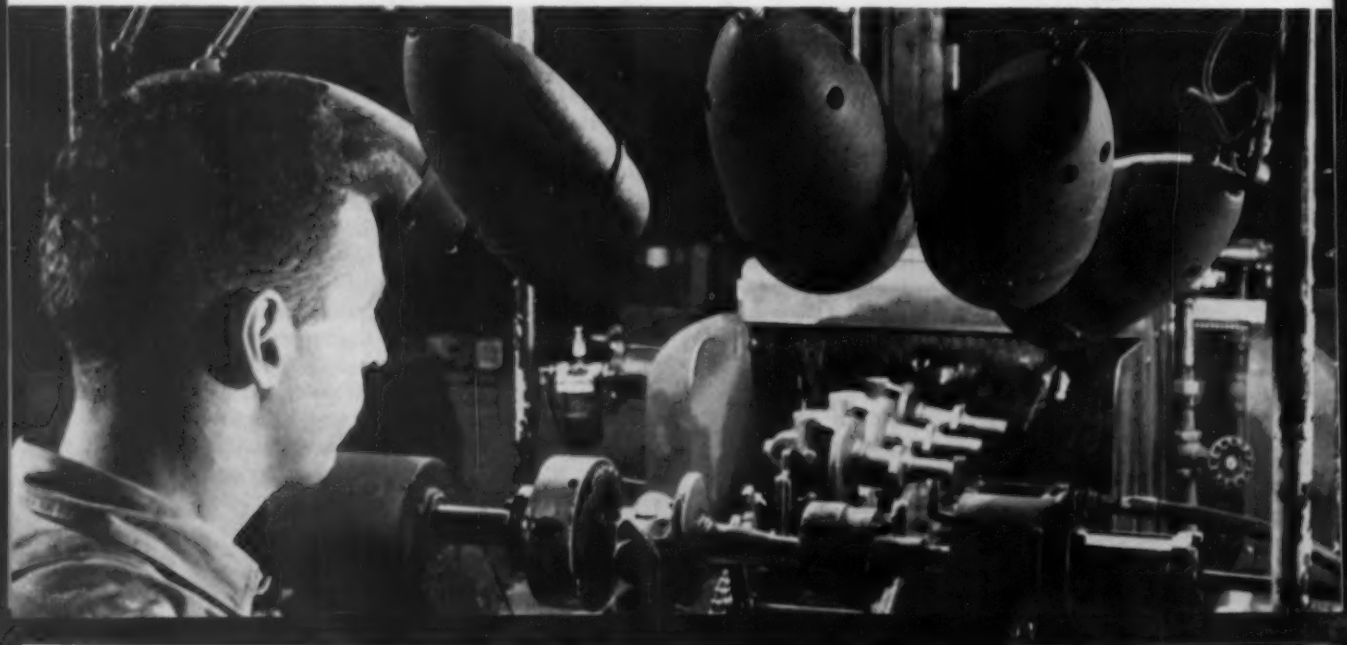
Moore Special Tool Co., Inc.

OPTICAL comparator checks precision stamping.

TESTING AND INSPECTION...

SETUP for mechanized magnetic particle testing.

Magnaflux Corp.



the present

PARTS TESTING and inspection has come a long way from the hardened template gages of Eli Whitney. Its importance in assuring uniform product quality, lowering costs and contributing to higher production has advanced so rapidly that some feel it should be given equal consideration with tools and other equipment in setting up a manufacturing operation.

Finer accuracy requirements and higher inspection costs are placing more and more emphasis on automatic gaging and inspection. Present automatic gaging and sorting operations are for the most part not tied in directly to manufacturing operations. However, installation of automatic gaging equipment into production lines is certain to see further development.

Progress in modern gaging

Modern gages built for automatic parts inspection not only check dimensions but hardness, compressibility, distortion, concentricity and surface finish. Automatic gages are mostly air, electronic or electromagnetic types which are magazine, hopper or manually fed.

Automatic inspection devices have been adapted for gaging and sorting piston pins, ball and roller bearings, sheets, ammunition, sparkplug bodies, rivets and magnets and many other parts.

Greatest progress in the use of automatic gaging for machine control has taken place in continuous manufacturing processes. One application is to control the diameter of plastic-coated wire after it leaves the extruder. Gages of this type can control wire diameter variations to within 0.001 in. Similar type units have also been applied to regulating the diameter and roundness of glass tubing.

Automatic machine control has found practical application on cylindrical grinding machines. Machine sizing controls are also used for between operation gaging in transfer machines which simultaneously process several parts.

Optical gaging has made great gains since its first application for inspecting screw threads. Thousands of optical gaging units are now used for checking a wide variety of items including such parts as precision stator laminations and root sections of jet engine blades.

Marked progress has been made by the basic metals and metalworking industries, during the past 2 to 5 years, in the integration of new and existing instrumentation with production processes. This has been spurred by the increasing emphasis on cost reduction, quality control and more rigid specifications.

Variables which formerly gave trouble and were responsible for many rejects and considerable downtime, are now being regulated in many plants with such laboratory-like precision that testing and inspection actually is becoming

an integral part of the production process.

The growth of radiation pyrometry has increased considerably in the past few years because of its ability to take a fast reading on moving objects. Most radiation pyrometers will measure temperatures from about 800 to 4000°F. With some units a reading within 99 pct of true temperature can be obtained in 0.6 seconds.

Dew point controllers are fairly recent developments in controlling heat treating furnace atmospheres. In some plant installations the instrumentation uses a humidity sensitive cell to which a minute flowing sample of gas is piped from the furnace. This senses the dewpoint temperature within plus or minus 1°C. One pen records dewpoint while another records ambient temperature.

Automatic carbon control integrated with temperature control is now being used by some heat treaters. Packaged units operate between 1500 and 1700°F for hardening, case carburizing, homogeneous carburizing or carbon restoration.

Instrumentation in the area of melting and rolling has made giant strides since the early 1930's. Instrument control can be applied to openhearth furnaces in half a dozen places. Principal applications are to automatically control furnace pressure, combustion and reversal. Properly applied, fuel savings up to 10 pct are possible, charging time is shortened, tap to tap time is reduced, refractory costs are lowered.

Another fairly recent development in present day steel processing is the substitution of direct reading spectrometers for wet chemical tests in analyzing heat samples. Along with steel mills and nonferrous melt shops, they are finding growing uses in production foundries, automotive and aircraft companies.

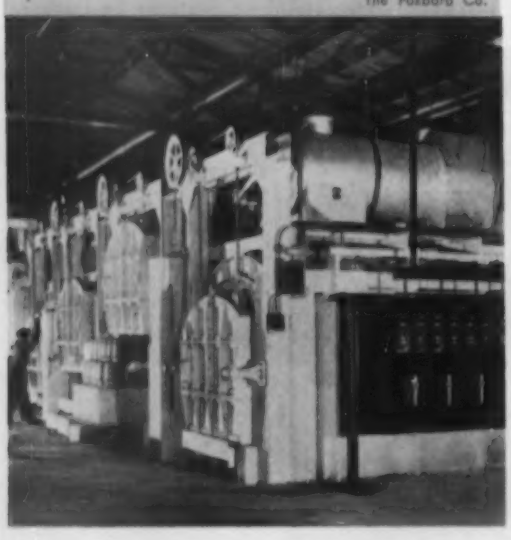
Growing application of instrumentation to strain gages is widening their use in the field of automatic control. Instrumentation associated with strain gages amplifies and measures output voltage accurately, provides calibrated indicators and makes contacts in control circuits which may be set up for operating, regulating or controlling electric, pneumatic, or hydraulic servo-motors.

A greater number of inspection methods are now available to the metalworking industry, ranging from simple visual or physical testing to the use of gamma rays. In some areas of inspection, the use of one method complements another. Some inspection methods have a relatively small area of use, while other methods overlap the entire testing field. Selection of the right method depends on (1) the type of defect, (2) production conditions and (3) cost considerations.

Visual inspection is the oldest and probably the most widely used test for defects. In recent years, however, other more reliable methods have replaced visual inspection in many manufacturing plants. For example, magnetic particle inspection, dye penetrant and other methods are replacing visual inspection in many operations.

Several special-purpose automatic and hand-operated fluorescent penetrant units are recent developments. During the Korean war, special automatic equipment was used to inspect gas turbine engine parts and wheels.

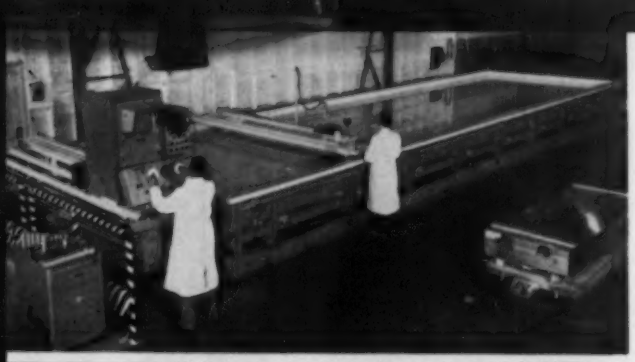
Within the past few years, a number of electronic instruments, some of which have been imported, have been adapted to American standards and practices. The first of these now being widely used is a conductivity meter which measures the internal conductivity of nonmag-

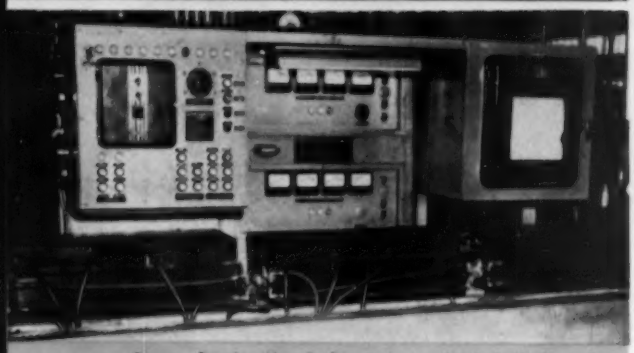


1 The Foxboro Co.



2 Gisholt Machine Co.





3 Douglas Aircraft Co., Inc. Leeds & Northrup Co.

1 PYROMETER controllers on draw furnaces play important part in control of heat treating.
2 FIVE DIAMETERS can be checked with air gage unit used on this shaft and spindle grinding setup.
3 Top: SOUNDNESS of large aircraft parts is checked in this immersion ultrasonic inspection unit.
3 Bottom: AUTOMATIC controls on this high frequency induction heater regulate power to coils.
4 SPECTOGRAPHIC analysis is used by more and more companies for control of metal quality.
5 STRAIN GAGES are connected to oscilloscope on this modern fatigue testing machine.
6 DIAL indicating gage is used by operator to check dimension during close contour grinding.

netic materials. This instrument uses only the external contact of the hand probe; the device operates by reactance from eddy currents induced within the materials. This new instrument for measuring conductivity of metals has proved useful in assessing many qualities of metals, including their conductivity, hardness, degree of cold work and other characteristics.

Develop portable X-ray units

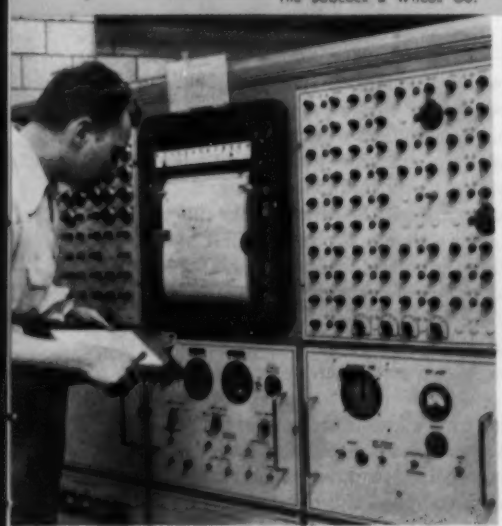
Concurrent with the introduction of pulsed and through-conduction ultrasonic testing, has been the development of an instrument that tests parts by sending out resonant ultrasonic waves within the material. This instrument is used at the present time primarily to measure the thickness of solid materials, ranging in size from 0.010 to 4.0 in.

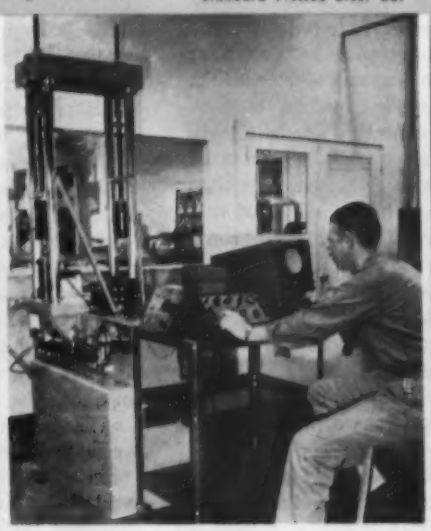
The magic of radiography which permits "seeing through metal" has been widely used by the U. S. metalworking industry, in addition to widespread application by the medical and dental professions. Spherical and cylindrical defects are readily disclosed, including internal pores, blow holes, and other discontinuities found in different parts.

The Betatron is a postwar development that operates under different principles from the original Coolidge x-ray tube. It permits deeper penetration than x-ray. Significant developments in making x-ray inspection portable have been made during the past few years.

Gamma ray is the name applied to radiographic inspection where radioactive sources are used. Best known of these radioactive elements is Cobalt 60. Gamma ray inspection has remarkable ability to penetrate hard metals of thick steel parts. Long exposures can be made, if desired.

4 The Babcock & Wilcox Co. 5 Standard Pressed Steel Co. 6 Moore Special Tool Co., Inc.







TESTING AND INSPECTION

the future

USE OF AUTOMATIC inspection devices in the production line and the controlling of process variables through improved instrumentation will play an increasingly important role in the future of the metalworking industry.

Major advantages to be gained are the obvious ones of higher production, lower unit costs and more uniform quality. But added to these are the need for the inspection functions to keep pace with the output of high speed, automatic machinery.

In many cases no longer is it possible to check the output of fast-producing units to the degree of accuracy required or at a rate which will take maximum advantage of their capacity.

In the future better inspection facilities will be combined with the impersonal approach of the mathematician to setup unbiased, inflexible quality control standards. The net result of this teamwork will inevitably be better, impersonal inspection at lower cost.

Physical testing will become increasingly automatic. An example of this is shown by one manufacturer who recently introduced a Brinell hardness tester into the production line. Tied in with automatic means for handling parts the new unit makes all the decisions of accepting or rejecting the part.

Another recently introduced fully automatic hardness tester incorporates photo transistors and intricate timing mechanisms in a Rockwell unit. It can test the hardness of both ferrous and nonferrous material at rates of 1000 to 1200 parts per hour.

Wider use of automatic inspection methods will be reflected in machine tool design. More machines are now being built with integral control units and more will be built in the future. Plants will as a result employ more electricians, highly skilled electronics men and specialists in hydraulic and pneumatic control units. Maintenance crews will be increased to keep machines operating and avoid downtime costs which will become more costly as machine capacity increases.

Within the immediate future the growing trend toward increased instrumentation of the production line and automatic parts inspection will undoubtedly increase the demand for more compact instruments with interchangeable com-



ponents. The new instruments though smaller, will have ruggedly built mechanisms which assure reliable performance, even under more difficult operating conditions. Anticipating this trend indicators, recorders and controllers are now being made of sturdy design with interchangeable components.

These instruments offer a preview of the industrial instrument of the future—instruments designed to make available accurate, dependable electronic control at low cost and in keeping with the constantly expanding instrumentation requirements of all the metalworking processes.

A major trend has been observed in special purpose testing equipment. This change has been noted in special equipment, often required in the aircraft and other industries. Here, interpolation of ordinary physical test data has sometimes been found to be unsatisfactory for predicting the behavior of materials in service under a wide range of varying stresses. For this reason, special testing equipment has been developed which imposes, either on a test specimen or a component, a variety of stresses in predetermined sequences.

The tests are, of course, a practical attempt to simulate actual service conditions and may include tests at high temperature as well as tests under corrosive atmosphere conditions. The new, special purpose test devices range from complicated equipment designed expressly for a certain set of service conditions, to standard physical testing equipment which has been devised for special conditions, including special adapters, fixtures, timing devices and special environmental chambers.

The trend in equipment for non-metallic materials has been quite similar to that for metals. Testing equipment is now available for performing tests on a variety of samples, ranging from microscopic samples to huge beams.

While the testing of manufactured units must of necessity be highly specialized, tremendous advantages would be realized if all industry establishes a greater degree of uniformity with respect to testing methods. This applies particularly to fatigue testing procedures. Increased use of fatigue testing equipment designed to test entire assemblies as well as manufactured parts can be predicted.

Under actual production conditions, testing for physical properties seems to be moving out of the laboratory and into the production department. This doesn't mean that testing laboratories are being closed; it does, however, mean that many of the new problems are primarily production problems.

Proving ground data will be used to an increasing extent to check final engineering designs. However, much of the original engineering work will continue to be done in the laboratory, using testing equipment that will be superior in many respects to the equipment in use today.

The trend to wider use of nondestructive testing methods will be stepped up. Radioactive isotopes will be applied more widely, small x-ray machines will be improved for greater use and ultrasonic testing methods will see further advances in technique and application.

Develop more compact units

New nondestructive testing instruments will make greater use of the electrical properties of materials for testing. Such instruments are now capable of checking metal analyses, measuring plating thicknesses, sorting materials, checking surface roughness, hardness or case depth, detecting flaws, cracks and internal voids.

Advance in the field of radiographic inspection will center around the development of smaller, more compact units, better testing techniques and more foolproof safety features. These will in turn make radiographic testing more available at a lower cost.

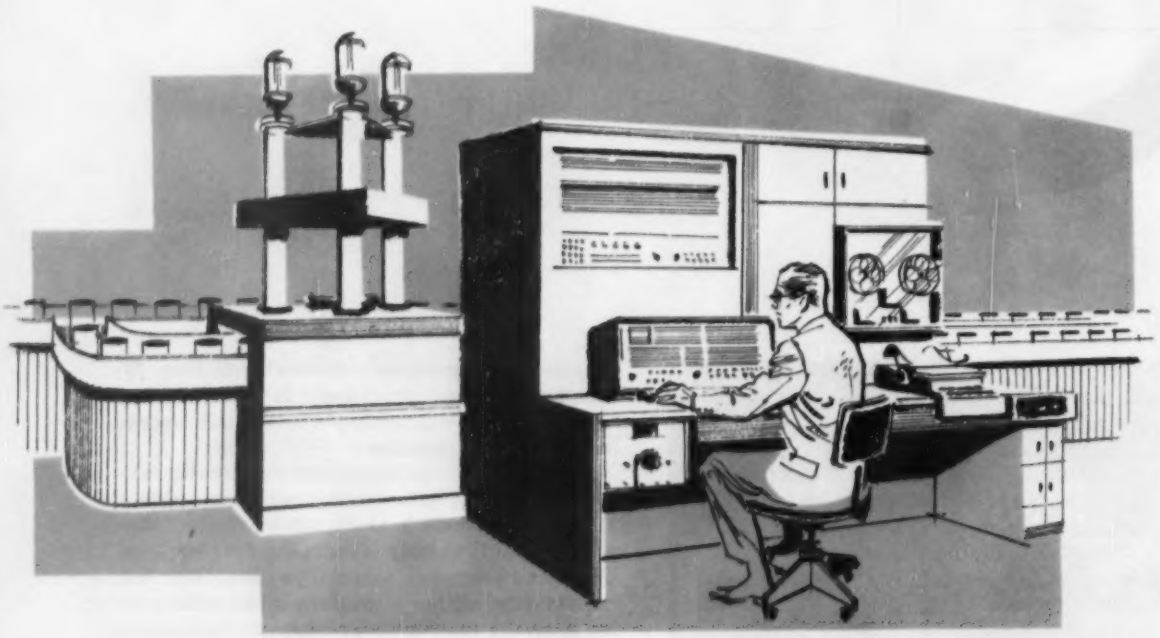
As more familiarity is gained with equipment and procedures ultrasonic testing will be used to a greater degree for checking internal cracks, flaws and voids.

Greater use of the direct reading spectrometer is assured for the future and will not be strictly limited to manufacturing operations. One company has speeded its warehousing operations through the use of this equipment. The machine analyzes metal samples and provides almost instantaneous readings on the percentage of each element in the metal. A big advantage was gained in replacing time consuming wet methods of chemical analysis.

Another new inspection method destined to play a greater role is the application of high speed motion pictures to analyzing operating machinery. High speed photography, however, makes possible the fast location of a defective cam, spring or other small part normally hard to find.

Quality control may be applied in the future to practically everything manufactured that can be controlled either dimensionally or by other means. Due to the widespread field of manufacturing applications, this also means a very broad scope geographically.

Quality control is not a cure-all for all plant production problems. However, when used in conjunction with sound processing methods under well-trained supervision, it is becoming recognized as a key industrial management tool.



TESTING AND INSPECTION unit of future is built around automatic testing machine, left. It uses wire resistance load cells at base of columns and in testing head which, combined with double acting hydraulic cylinders, permit wide range of tests. Punched tape programmer controls machine and read-out is on magnetic tape in addition to oscilloscopes or pen and ink recorders. Load and strain can also be run into computing machines for quality control.

Setup shown here on production line includes magnetic particle unit to spot flaws and x-ray spectrograph to automatically analyze and record the chemical composition of inspected parts.



the
Van de Graaff®
Model JR offers

Wide-range Flexibility
for industrial radiography

Whether your inspection problems include

- high-quality production radiography of ½-inch to 5-inch steel sections
- aluminum, bronze, or stainless steel
- panoramic x-ray exposures of welded seams or groups of castings
- detection of hairline cracks or of microporosity

The model JR is the answer

- with its constant-potential one-million-volt radiation, by means of its 1-mm x-ray focal spot
- with sturdy design requiring no external cooling, no auxiliary apparatus
- well suited for complete transportability or cabinet type installation

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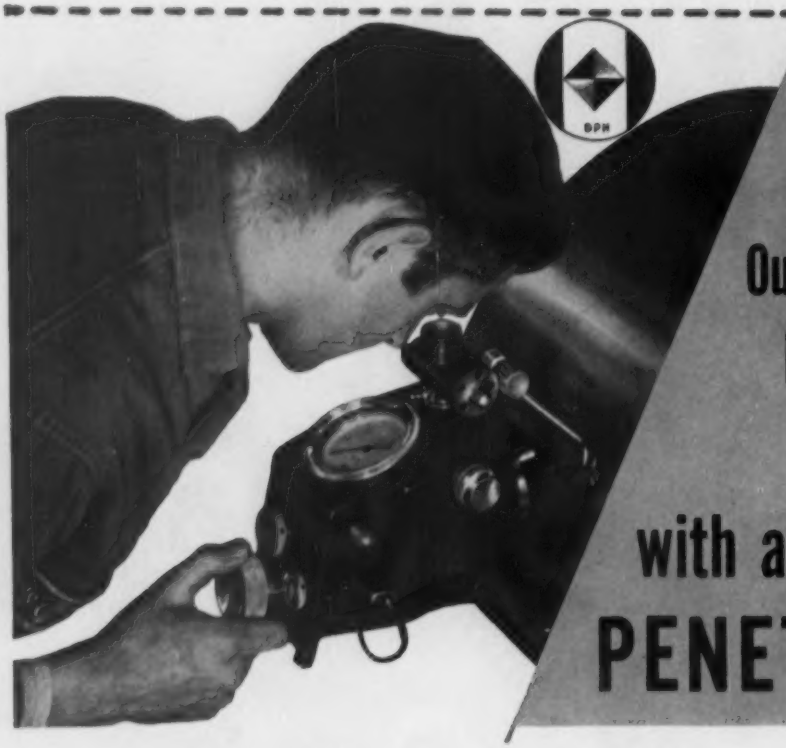
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QUOTES: 1855—1955

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ACKNOWLEDGMENT

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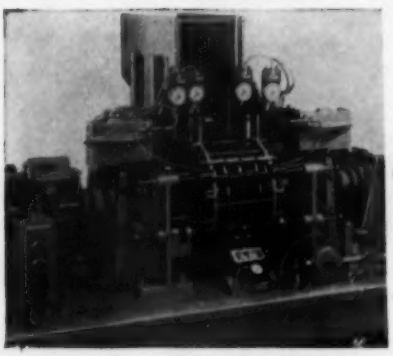
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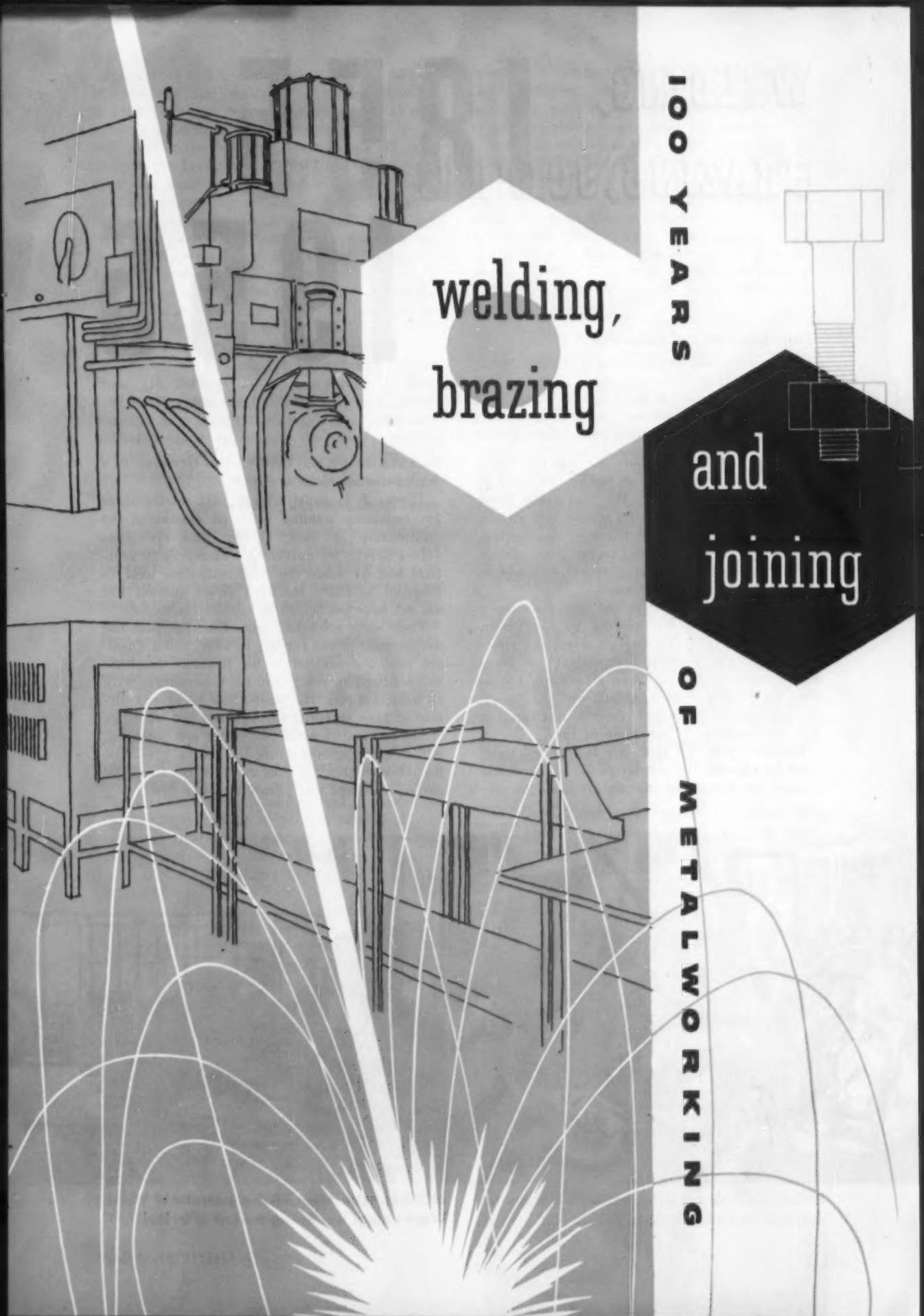
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welding,
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100 YEARS
OF METALWORKING

WELDING, BRAZING, JOINING 1855 1955

Welding closely parallels the technological development of metals. As early as 5500 years ago, the Egyptians made pipe by hammering copper into sheets, formed it, then joined the edges by hammering. From these early days until recent years metals have been joined for many purposes, but seldom to withstand any great stresses.

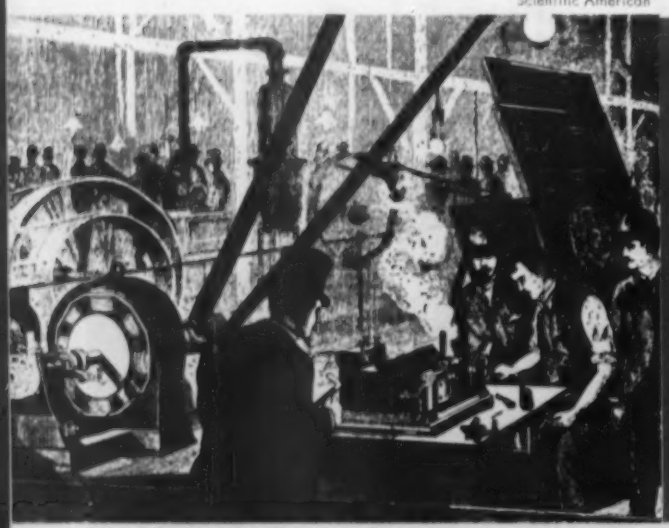
Not until centuries later did new discoveries lay the foundation for welding by the fusion processes. In 1774, the English scientist Priestley, and Scheele working independently in Sweden, discovered oxygen. Soon afterward, Lavoisier, the French chemist, established the theory of combustion. Edmund Davy's contribution was the discovery of acetylene in 1837.

Between 1806 and 1809, Sir Humphrey Davy tried to unravel the mysteries of an electrical charge. He discovered that an arc could be created and maintained between two terminals of a high-potential electric circuit.

It was J. P. Joule who in 1841 set the stage for resistance welding when he discovered the relationship of heat, current and resistance ($H=I^2RtK$). By putting his discovery to practical use, he made the first resistance weld in England in 1857. He used direct current but did not have the benefit of contact resistance.

These early scientists seemed to anticipate the development of the future. In 1877, Elihu Thomson read a paper before the Franklin Institute in Philadelphia, describing his experiments with an induction coil. He related how he passed current of high potential through the fine windings of the coil and received current of low potential, but of great volume, from the coarse windings. He observed that the ends of the wires from the coarse windings had joined together firmly.

Scientific American



THOMSON'S electric welding process is shown to visitors at American Institute Fair in 1887.

The Lincoln Electric Co.



MOBILE engine-driven welding generator of World War I vintage was among the first of its kind.

It occurred to Thomson that this might be an effective and fast method for uniting metals. In 1883, he began work on an experimental resistance welding machine. He completed it in 1885, and in the following year applied for and received the first patent in the United States on resistance welding. His claims were very broad.

Thomson got busy quickly to supply industry with resistance welding machines. By 1888, he improved the equipment, and founded the Thomson Electric Welding Co. In the next few years, he sold scores of machines and put the infant industry on a fairly firm footing. He was a prolific inventor, acquiring nearly 100 patents on resistance welding alone.

Other inventors had also made notable contributions. C. L. Coffin of Detroit was one of these. In 1889, he received a patent on flash butt welding, and the following year he obtained four patents on spot welding, using electrodes probably made of copper. Robinson's patent, granted in 1897, is considered the first on projection welding.

Spot welding becomes legal issue

Resistance welding became a big issue in 1903—a legal one. Harmatta of the Thomson company obtained a patent on spot welding as a new resistance welding method. This was about two years after McBerty was credited with the first commercial use of spot welding. This led to a long and bitter court case. The Supreme Court ended the litigation in 1924 by ruling the Harmatta patent invalid, contending that the original Thomson patent applied to all forms of resistance welding.

The need for increased production during World War I gave resistance welding added impetus. Resistance welding played its role well and helped to achieve new production records. Shortly thereafter, emphasis again turned to further improvement in process reliability. By the early 1920's, spot welding electrodes of copper-tungsten alloys began replacing those of hard copper. This extended electrode life considerably.

Electrically controlled machines made their debut in 1924. A flash butt welder, after loading only required the touch of a foot pedal to start the machine through an automatic cycle lasting about 2 seconds.

New installations broke old production records. Not only did welding cycles get shorter, but equipment became larger. Installation of resistance flash welding equipment for pipe line at the A. O. Smith Corp. in 1927 was a typical example. Longitudinal seams in 440-ft lengths of large-diameter pipe were welded in 30 seconds. Production increased to 26 miles of pipe per day. Until that time, total production capacity of the entire industry was only about 3 miles per day.

The decade of the 1930's was highlighted by many refinements in equipment. First were the knurl drive and multiple rolls for seam welders. The "thyratron" tube began to replace the contactor and made it possible to interrupt current as many as 1000 or more times per minute.

Machines were developed a few years later to draw balanced loads from power supply lines. These included the three-phase stored-energy and direct-energy systems. Synchronous and nonsynchronous timers followed in short order. During the 1940's, means were found to drastically alter the wave characteristics of alternating current. This improved the physical and metallurgical properties of welds in certain metals and alloys.

Arc welding has sucessful start

Arc welding started in the late 1800's—1881 to be exact. It was Auguste de Meritens who first used the heat of an arc between the workpiece and a single carbon electrode. He connected the positive side of the circuit to a plate which supported the work while the carbon electrode served as the negative pole. With this setup, he successfully joined together parts of lead storage battery plates.

Benardos and Olszewski saw the potential of the process and obtained a patent in 1885, also on a single carbon electrode tool. Benardos went a step further when in 1887 he proved that the carbon arc could be used for joining ferrous metals. He lost little time in promoting his process and demonstrated it as a repair method.

Other inventors meanwhile looked for ways to improve the Benardos process. Prominent among these was Charles L. Coffin of Detroit. He developed and applied for a patent in 1888 on a twin electrode process which not only melted the filler metal, but supplied sufficient heat to cause extended fusion of the base metal.

RESISTANCE spot welder built by McBerty in 1901 highlighted long litigation which ended in 1924.

The Federal Machine and Welder Co.



Slavianoff also worked out a process in 1889. However, his process differed from Coffin's process in that, as Slavianoff himself described it, "two pieces of metal may be united by casting metal into the space between them." It was actually an arc casting process for filling holes, cracks and other defects in castings.

The metal electrode still had many shortcomings by today's standards. Welds were lacking in essential properties, welding rates were slow and control of the arc was difficult. Wash coatings of clay, lime and other materials on the electrode improved welding action somewhat but not enough to obtain good arc control.

Arc welding took a big step forward when Kjellberg discovered that the application of a heavier electrode coating resulted in a "simple and practical method of welding whereby the welding of joints on the lower sides of objects can be easily effected." His patent application of 1907 also claimed that the coating material could be formulated so that it "effects mechanical or chemical changes" in the weld metal.

Kjellberg evidently did not realize at first the significance of his discovery. In 1912, he filed for and received a second patent. It described more specifically the electrode materials, coatings, minerals for slag formation and diverse ferroalloys, all of which were claimed to have some effect on altering weld properties. Welds were superior to those made with bare electrodes.

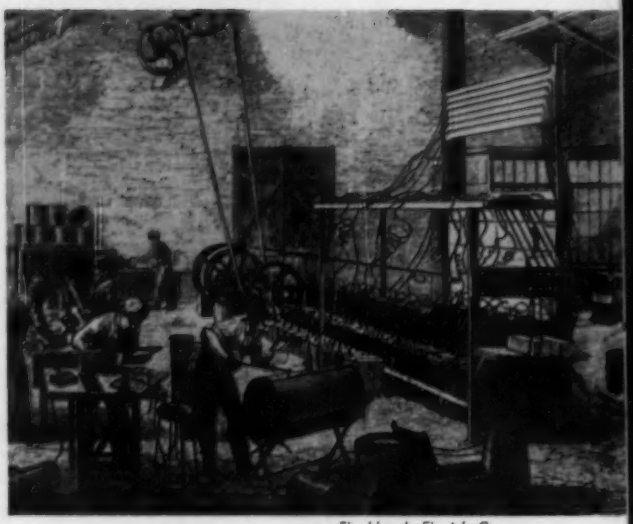
Solid electrodes with extruded coatings of the gas-shielding type were made by A. O. Smith Corp. for its own use in 1927, and Lincoln Electric Co. produced them commercially in 1929. In the early 1930's, iron powder, cellulose and titanium were finding greater use in coating materials while use of silicate, asbestos, fluospar and lime was on the decline.

Structures designed for welding

Metal arc welding grew at a very fast rate in the late 20's and early 30's. More thought was now given to designing structures specifically for welding. Many ships, tanks, buildings, pipe lines, bridges and other structures were welded successfully. This established confidence in the process among metal fabricators. In 1931, welding codes were adopted for all-welded power boilers and unfired pressure vessels. In the same year, a report was approved which established the safe stress limits in steel structures.

Progress in oxyacetylene welding and cutting closely paralleled that of metal arc and carbon arc welding. Oxygen had been discovered in 1774 and acetylene in 1837, but the oxyacetylene processes did not gain a firm foothold until after methods had been found for producing these gases in large volume.

The principal developments in the oxyacetylene processes came within a short span of years. In 1884, Wroblewski and Olszewski discovered a means for liquefying air. By 1890, equipment was in use for producing oxygen by electrolysis of water. Dr. Carl von Linde worked out the technical details, three years later, on equipment for producing liquid air—the source for commercial quantities of oxygen.



The Lincoln Electric Co.

CARBON ARC WELDING shop of 1800's received power from banks of batteries. Dynamo is at right.

Meanwhile, some important work was being done in Spray, N. C. In 1892, Thomas L. Willson performed some experiments in which he heated lime and carbon in an electric furnace. The product of this reaction was a hard substance from which gas evolved when immersed in water. This substance proved to be calcium carbide and the gas was identified as acetylene.

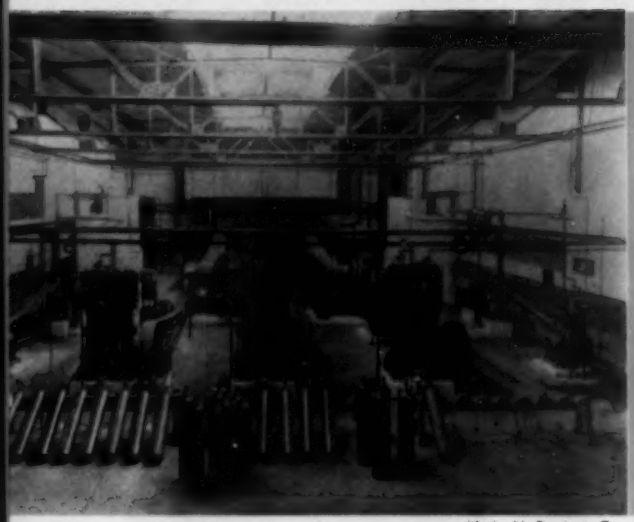
A third development which laid the groundwork for the oxyacetylene processes was a discovery by Le Chatelier in 1895. He described to the French Academy of Sciences how he obtained a flame temperature of 6000° to 7000°F by the combustion of acetylene with oxygen.

Equipment was now needed to handle the high-temperature flame. Fouche and Picard, in 1901, designed a suitable torch which drew acetylene from a cylinder under pressure of 15 psi. In 1903, Fouche developed another torch for use with a low-pressure acetylene generator.

Acetylene production gains

By 1904, calcium carbide production was high enough to satisfy the acetylene requirements of industry. Oxygen production was still lacking. To overcome this deficiency, Linde Air Products Co., in 1907, built the first commercial oxygen plant in America.

While oxyacetylene welding was still in its infancy, C. Vautin came upon another important discovery in 1895. Experimenting with methods for reducing metals from their oxides, he found that a cold mixture of metallic oxide and powdered aluminum, when ignited, would supply enough heat to propagate the reaction through-



Linde Air Products Co.

FIRST OXYGEN PLANT in America had three interchangers. Cylinders were filled on rack.



Linde Air Products Co.

OXYACETYLENE setup is typical of those used around 1906. Cylinders were made by brazing.

out the mixture. A single reaction lasted less than 30 seconds and created a temperature of more than 5000°F. It was the beginning of thermit welding.

Dr. Hans Goldschmidt applied Vautin's process in a practical way by welding together iron bars. He obtained a patent on this process and introduced it to the United States in 1902. It proved highly effective for repairing rails, ship rudders, mine equipment and other objects.

In more recent years, the submerged arc and inert-gas processes have assumed great importance. Submerged arc welding, which permitted the use of high current densities, was first used commercially in 1934 at the Consolidated Steel Co., Los Angeles.

The idea of using an inert gas for weld protection dates back to about 1890 when carbon dioxide was proposed. In 1920, Hobart and Devers studied the effects of various gases on an electric arc and reported that helium and argon were satisfactory for effective weld protection. Basic patents for welding in a helium or argon shield, using a refractory electrode, were granted to them in 1930. First commercial use of this process was by Northrup Aircraft, Inc. in 1940 for joining magnesium and magnesium-alloy assemblies.

Feeding of a continuous consumable rod into a blanket of inert gas had been considered for many years. However, no practical method had been developed until 1948 when the Air Reduction Sales Co. introduced it for the first time.

Joining of metals with fasteners has a history extending almost to the beginning of civilization. Their greatest impact on the affairs of man has been made during the past century.

It was only about 1855 that the manufacture of fasteners was becoming an industry of its own. Before that time, bolts were largely hand made in local blacksmith shops, with no interchangeability. Although practically every branch of industry used bolts, few firms had attempted to make them in volume for sale at a profit.

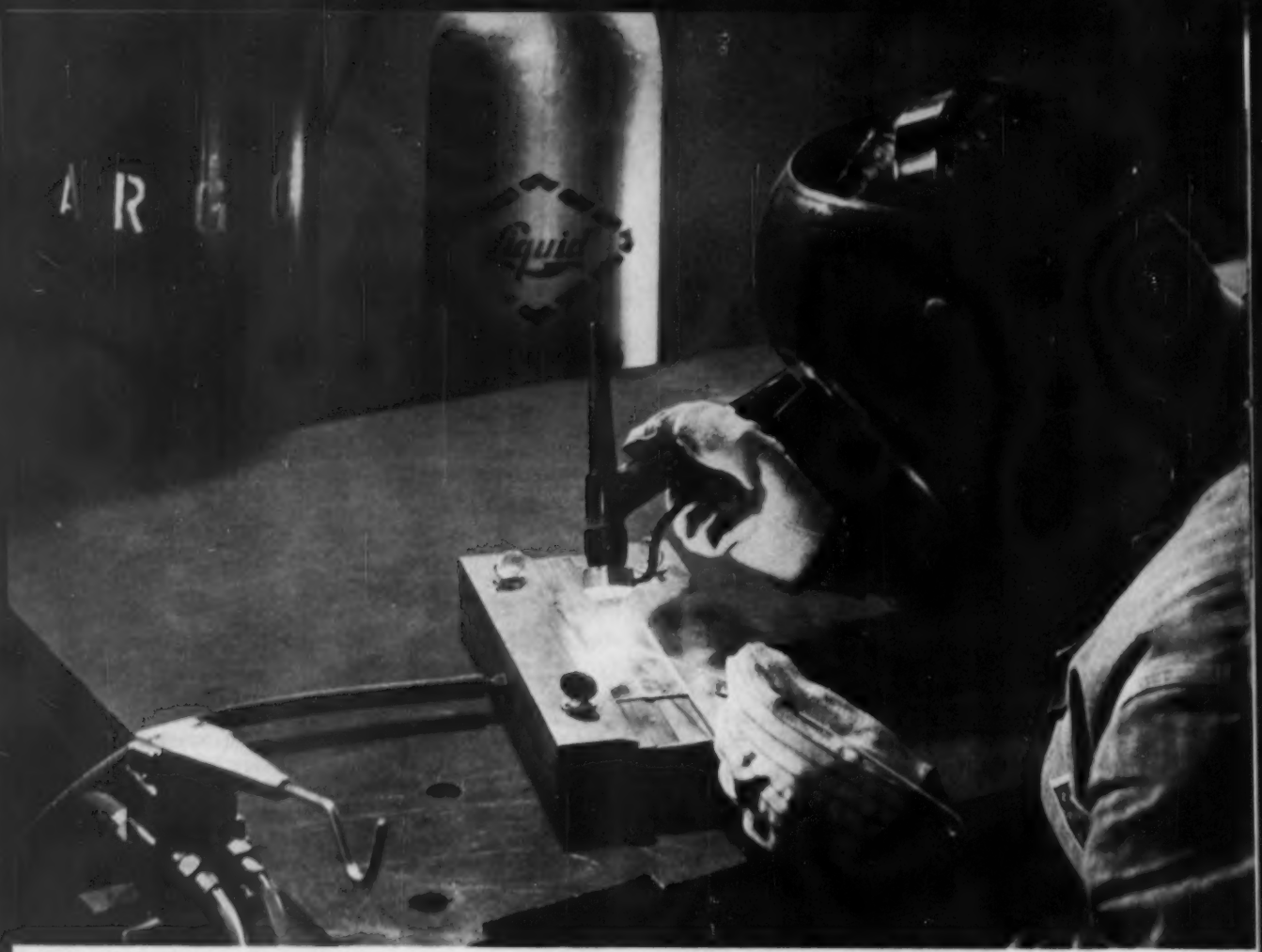
The history of the screw is similar. Forms of screws had been used in a limited way since the Bronze Age 3000 years ago, but their manufacture in great volume began only slightly before 1855. Even then, the use of partly automatic screw machines already had cut the cost of screws in half.

Railroads open market for fasteners

The great reduction in the cost of screws and bolts, together with their vastly increased production, contributed directly to much of the complex machinery of today. With low cost fasteners, many of the things taken for granted never would have been developed. By 1860, the railroads had begun to grow at an unequalled rate. This opened a fine market for the producers of fasteners; and more important, the railroads exerted pressure for standardization.

The industrial revolution had begun. Through the years, the fasteners industry was successful in keeping pace with America's great industrial expansions—including the development of railroads, farm machinery, shipbuilding, automobiles, household appliances and finally airplanes.

During the past century, these technological changes have been outstanding: development of the rivet, improved methods of cold heading, thread rolling and automatic thread grinding. As industry presented the need, variations of existing products were developed—resulting in such unique items as the recessed head screw, tapping screw, preassembled lock washer screw, locknuts, locking bolts and blind rivets or bolts.



CO_2 SHIELDS tungsten arc weld. Liquid Carbonic Corp.

WELDING, BRAZING, JOINING...

MIG welding is fast, clean, spatter-free. Linde Air Products Co.





WELDING has become an indispensable means of producing goods in American industry. It is the primary process in manufacturing many items and greatly facilitates production of many others. In 1953, total sales of welding equipment and materials in the United States amounted to nearly $615 million. About 85 pct of this equipment and materials was purchased for production operations.

Today, there are about 35 different welding processes. In recent years, nearly every one has been subjected to intensive scientific and technical investigation. Much of this work has been done to improve weld quality and reduce production costs. Some of it stems from problems encountered in the production of military equipment, atomic energy work, and joining metals for high-temperature service.

Based on the total weight of metal deposited, metal arc welding is still the "work horse" of the metal joining industry. While applicable to a number of common metals, its chief usefulness is in welding steels about 1/16 in. and more in thickness. It is highly flexible and well suited for welding in all positions. Although widely used in production, it has also been extremely useful in maintenance and repair operations.

Successful application of metal arc welding depends largely on the type of electrode used. For years, six types of coated electrodes have been available. These are still completely satisfactory for many uses.

Electrodes having coatings with a "low-hydrogen" content have been developed for welding low-alloy steels which are susceptible to porosity and cracking due to hydrogen. Recently, electrodes bearing iron powder in their coatings (contact type) have been introduced commercially. The iron powder increases the rate of metal deposition and reduces the amount of effort and skill required of the operator. Arc length can be controlled by holding the electrode in contact with the work.

Submerged arc welding is chiefly used in welding steels of about 1/16 in. or more in thickness. Although limited largely to work in the flat position, equipment has been developed recently for welding horizontal and vertical seams in field erected tanks. The process is characterized by very high rates of metal deposition. It is well suited for the production of heavy assemblies which can be positioned for the welding of long joints.

Until recently, submerged arc welding was mostly mechanized. Manually operated equipment now gives the process a much higher degree of flexibility and increases its usefulness. Another advance has been the use of multiple electrodes to obtain higher deposition rates. By varying the electrical connections and the positions of the electrodes with respect to each other, the depth and width of the fusion zone can be controlled.

Great strides have been made in recent years in the field of inert-gas-shielded arc welding. There are two principal forms of this process: the tungsten electrode form (TIG welding) and the consumable electrode form (MIG welding).

TIG welding is applicable to a great variety of metals and alloys including aluminum, magnesium, copper, nickel, titanium, steel and stainless steel. It has no particular process limitations with respect to section thickness, but its chief field is in welding thinner sections. It is applied both manually and mechanically.

Two new electrodes have been developed for TIG welding. In one, a trace of thorium is added to the tungsten. The other contains a small amount of zirconium. These additions improve arc starting, give the electrodes longer lift, and aid arc stability.

When filler metal is required, bare welding wire can be fed into the arc continuously by mechanical equipment. A modified form of the process, arc spot welding, is used for welding sheet metal to a supporting structure or for joining two sheets by means of a lap-type joint.

The MIG process is suitable for welding thicker sections because of its high rate of deposition. Bare wire is fed by electronically controlled mechanical equipment from a continuous coil into the arc which melts it to provide filler metal.



1 Morgan Engineering Co.

Uses high current density

Successful MIG welding depends on the fact that when the current density in amperes per square inch of area at the electrode tip exceeds a critical value, a very favorable condition exists for rapid melting of the electrode. Metal is transferred to the work with a high degree of arc stability. Usually, a smaller electrode and a higher current are used than in ordinary metal arc welding. The process is used principally for nonferrous metals including titanium, stainless steels, and low-alloy steels. It is particularly well suited for welding aluminum.

The electric resistance welding processes are indispensable in the mass production of metal products ranging from tiny assemblies for electron tubes to streamlined railroad cars. There are five basic forms which are used on a variety of metals—spot, seam, projection, flash-butt and upset-butt. Except for butt welding, these processes are limited to relatively thin sections.

Resistance welding is more readily adaptable to mechanized, semiautomatic, and fully automatic applications than other welding processes. Three-phase resistance welders are used extensively for welding aluminum aircraft assemblies where single-phase machines present a power supply problem.

Modern machines provide rapid follow-up of electrodes to compensate for the plastic flow of metal in the weld. The moving electrode in one type of welder is accelerated by a magnetic



2 Lincoln Electric Co.

force produced by the welding current itself. Electronic circuits control the rate at which the current increases at the start of each pulse. This is known as slope control.

Another type of electronic control makes possible the heat treatment of welds by the passage of a series of controlled pulses of current. This is known as program control.

Research on flash-butt welding is beginning to influence the design and operation of welding machines. Apparatus is now available for evaluating the surface condition of metals to be welded by the resistance processes.

Oxyacetylene welding is still one of the more widely used processes. Because it is usually applied manually it can be used for welding in all positions. It also permits the operator to have complete control over metal depositions at all times. With this process, many of the common metals can be welded in nearly all thicknesses. It is still considered one of the best processes for welding gray cast iron.

Another process which permits the operator close control over metal deposition is atomic hydrogen welding. This process provides a very intense and clean source of heat. One of its major uses is that of altering and repairing steel die blocks.

Stud welding as the term implies, is used for joining studs perpendicular to the work surface. Two different forms of the process are in common use. One, essentially a modified metal arc process, welds steel studs of varied sizes and shapes to steel bases. The second, similar to electropercussive welding, is applicable to the welding of nonferrous studs to nonferrous base metal, sometimes with dissimilar stud and base metal compositions.

In thermit welding, a chemical reaction between powders of aluminum and an oxide of

1 TWIN HEADS on submerged arc welder can weld seams 110 ft long at speeds up to 120 ipm.

2 WELDING of horizontal and vertical seams by submerged arc process speeds tank construction.

3 SHELL MOLDS replace lost wax process for preheatless thermit welding of reinforcing rods.

4 SPOT WELDING by the inert gas-shielded process is fast, clean, spatter-free and flexible.

3 Metal & Thermit Corp.



4 Air Reduction Co., Inc.



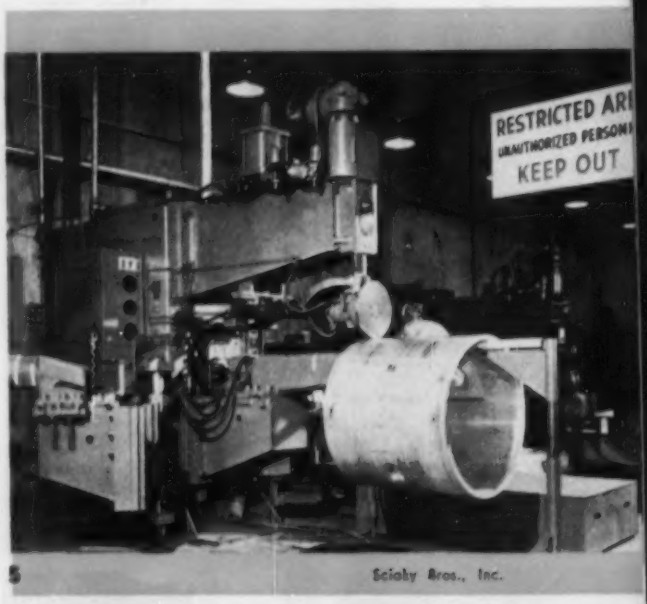
the filler metal provides heat and molten filler metal. It is used principally for joining heavy sections of steel and gray cast iron where much filler metal must be provided quickly.

While sand molds are generally used to confine the filler metal for joints of unique sections, there is a trend toward the use of semi-permanent molds where many identical joints between smaller sections must be welded. An example of this type of application is the welding of steel reinforcing bars for concrete construction. A modification of the process, cad-welding, is used for welding butt joints in copper conductors.

Enormous numbers of individual welds can be made per day by electropercussive welding. Parts to be joined are brought together by sudden impact and a simultaneous discharge of electrical energy of very short duration between the parts. The process is extremely fast and melting is confined largely to the surfaces exposed to the heat of the arc.

Welding of butt joints between small lead wires for electric lamps and electron tubes is one of the principal uses for electropercussive welding. The welds are made automatically at rates of about 200 per minute. A new application is in the manufacture of telephone relays requiring 12 welds per unit. The process is also applicable for welding studs to flat surfaces.

Two methods are in use for welding metals by induction heating. One method is a fusion process while the other is a hot pressure welding process. Induction welding is limited to joints which provide a closed path for the flow of the induced currents, and to metals having relatively low electrical conductivity.



Sciaky Bros., Inc.

Cold welding a newcomer

Cold pressure welding, using only pressure and no heat, is a relative newcomer to the welding field. The main use is in welding lap joints between aluminum sections ranging from foils to medium-thick sheets. It is also applicable to lap joints between copper sections and to butt joints in aluminum and copper wires. Metals to be welded by the cold pressure process must be in a relatively "soft" condition.

Welding tools are relatively simple, consisting of devices for applying sufficient pressure to produce plastic flow of metal at the joint between the parts being joined. While plastic flow of metal is necessary to obtain a weld, the displacement of metal may limit application of the process in certain cases.

Hot pressure welding processes differ mainly in the method by which heat is obtained. Fusion does not occur in the usual sense in any of these processes. They are usually used for welding butt joints in rails and pipe. The parts to be joined are first butted against each other under light pressure. The metal at the joint is then heated until it becomes plastic. The pressure is then increased to complete the weld.



6 Handy & Harman

5 GIANT press-type roll seam welder joins fuel-carrying sections for aircraft at high speeds.

6 VALVE BODIES pass gas flames in endless chain to be silver brazed at rate of 1080 per hour.

7 OXYACETYLENE flames heat joint in shaft under pressure to form weld of high quality.

8 ELECTRIC EYE tracing unit accurately guides oxyacetylene torches in cutting operation.

The hot pressure processes include: (1) oxyacetylene pressure welding, (2) upset butt welding, (3) thermit pressure welding and (4, induction welding. These are mainly used for welding steels. Welds generally display some of the metallurgical and mechanical characteristics of hot-forged metal due to the hot working which takes place in the welding operation.

Welding is frequently used for surfacing a base metal with another material. This improves either the abrasion or corrosion resistance of the base metal, or both. Hard facing, for example, consists of depositing a hard alloy onto the base metal to protect it against abrasion. Bronze surfacing provides mild steel with a good bearing surface. And stainless steel is frequently applied to mild steel for better corrosion resistance. The welding processes most frequently used for surfacing are: manual metal arc, submerged arc, oxyacetylene, and inert gas-shielded metal arc welding.

Welding has been made more useful by the fast, economical and accurate methods of cutting metals into the shapes required by modern design. Flame cutting is used almost universally for this purpose. The process is limited to steels and gray cast irons.

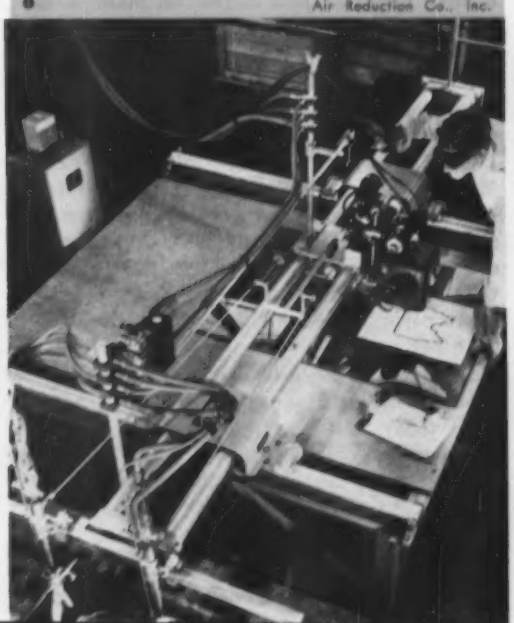
In relatively recent years, the process has been modified for cutting stainless steels by the introduction of flux or iron powder into the cutting oxygen stream. The modified forms of the process are known as flux injection and powder cutting. Both forms can be applied manually or mechanically, but most operations are mechanized.

Another method of cutting metals employs an arc struck between a special metal electrode and the work. A stream of oxygen passes down a small passage through the center of the electrode until it strikes the hot work. Here, it

7 Linde Air Products Co.



8 Air Reduction Co., Inc.



proceeds to cut the metal by essentially the same action as in flame cutting. The process is applied to a variety of ferrous and nonferrous metals including steels, stainless steels, aluminum, copper and other metals.

The last 10-year period has experienced a rapid growth in the development and industrial use of adhesives for bonding many types of material such as glass, metals, foamed plastics, laminates of foil, paper, plastics and leather.

Industrial abrasives are now made from such materials as synthetic rubber (solvent, latex and thermosetting), reclaimed and natural rubber (solvent and latex), thermosetting synthetic resins and oleoresin.

Uses of these materials range from bonding brake linings and shell halves used in shell molding to bonding metal to glass on highly critical applications. Fabrication of sandwich panels is one new growing field made possible by the introduction of high strength industrial adhesives. Lightweight panels are finding increasing use in curtain and structural walls, and truck bodies. Sandwich panels, which may have skins of metal, plywood or hardboard and cores of foamed plastics, plywood and metal or paper honeycomb, have high strength-weight ratios.

Industrial adhesives frequently offer product designers the opportunity to make more compact and efficient products. Often times, their use can save substantially in material and production time.

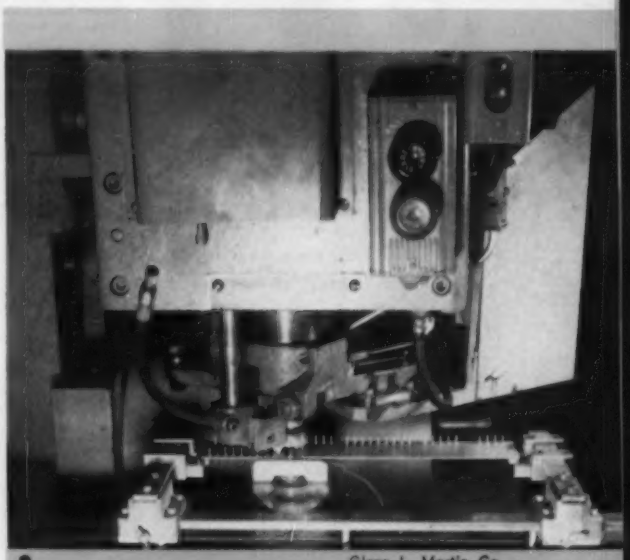
Curing time speeded

One outstanding example of the effect of industrial adhesives have brought about is illustrated by the plastic laminate bonding process. Adhesives for bonding wood laminates for tables and counters formerly required curing ovens, hydraulic presses and long curing times. Now, with a synthetic rubber adhesive, over 400 laminated wood panels are made hourly.

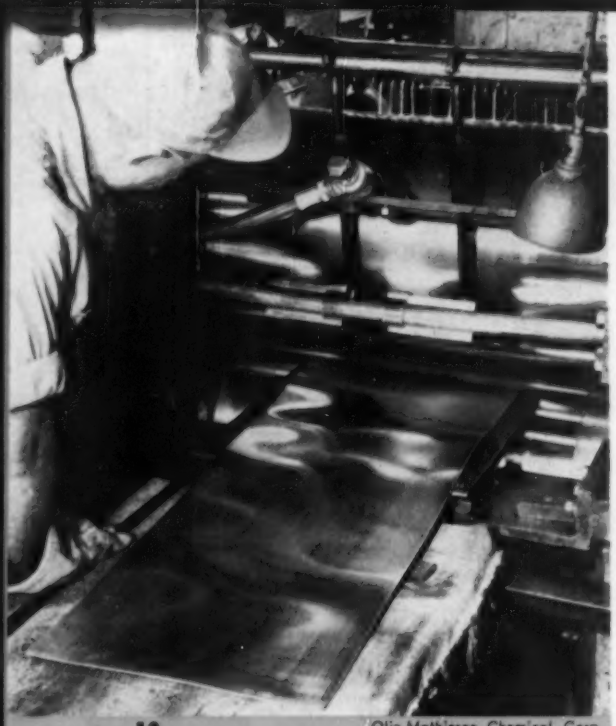
Another striking use of industrial adhesives is that of joining friction materials to clutch plates. Industrial adhesives make possible a reduction in the amount of friction material used, stronger fastening and more compact units.

The fasteners industry, too, has progressed far from its blacksmith shop stage of 100 years ago. The industry uses 2 pct of the national steel output, employs about 30,000 people, and turns out about 200 million pieces per day, or 50 billion per year. About 400,000 different standardized items are available. Among bolts alone, an individual can purchase anything from a bolt 4½ in. in diameter (the nut to which weighs 27 lb) down to a bolt ⅛ in. long with microscopic threads and running about 3000 bolts per pound.

Many types of fasteners once hot forged by hand in the blacksmith shops are still being made today. But now they are stronger, more uniform, finely finished and produced at a rate of 6000 per man-hour in modern plants.



Glenn L. Martin Co.



10 Olin-Mathieson Chemical Corp.

9 AUTOMATIC riveting machine drills holes and inserts lugs at triple the previous rate.

10 ALUMINUM plates emerge from bonding rolls after being welded under pressure without heating.

11 VINYL film applied to magnesium sheets forms an excellent material for making luggage.

11 United States Rubber Co.



Perhaps the most impressive thing about the fastener industry today is that bolts, nuts and rivets—up to 200 million per day—are made to exceptionally close tolerances. With fasteners, interchangeability is a fundamental and astounding thing. They are reliably interchangeable with each other from the same plant, as well as with the product of any of the more than 300 plants that produce the item.

Although some of the basic principles of fastener production were patented nearly a hundred years ago, new ways have been found to apply them. The extensive use of thread rolling is an example. Originally the process was crudely accomplished by rolling the stock between two flat dies. The first thread rolling machine was patented in 1860.

Superior dies and improved methods have brought this art to an exceptionally precise level. Today, stock may be inserted between two or three cylindrical dies with grooves of the profile of the threads desired. With this method of rolling, a screw of endless length can be produced.

When even greater accuracy is desired, threads are ground on an automatic thread grinder, generally using a single point, diamond dressed wheel. The accuracy stems from the ability of this machine to true its own grinding wheel, then automatically compensate for the amount removed by the wheel—thus keeping constant the diameter of the pieces being ground.

Another significant development beyond the imagination of the industry of 1855 is the wide use of time savers such as locknuts, lock bolts, and recessed screws. All of these have improved methods of doing the job, reducing costs and speeding assembly.

High speed production now is reaching even more fabulous levels. There is a new rotary threader which roll threads small screws in quantities up to 2500 per minute and slots them up to 1500 per minute. This produces an almost continuous spurt of parts at high speed.

Development of the self-tapping screw (1917) gave a tremendous assist by providing a screw which could be driven into metal as easily as wood screws into wood. It is estimated that it saves industry millions a year in assembly costs.

Assembly of small parts has been speeded considerably by the use of screws in stick form. The screw sticks are fed into air-powered screwdrivers, permitting a single operator to drive as many as 1500 screws per hour. The power drivers are compact and lightweight so that an operator can hold the part with one hand and drive-fasten with the other.

Sticks in screw form are made of steel, brass, aluminum and nickel-silver alloys. Their threads are of two types—machine and self-tapping. Each stick consists of 24 to 60 screws. This new technique now makes it possible to use screws in locations previously inaccessible.

WELDING, BRAZING, JOINING

the future

WELDING'S future will probably be distinguished by the extent to which its productivity is increased by mechanization and automatic application of the various processes. Electric resistance welding and inert-gas-shielded arc welding will likely play leading roles with respect to fully automatic applications.

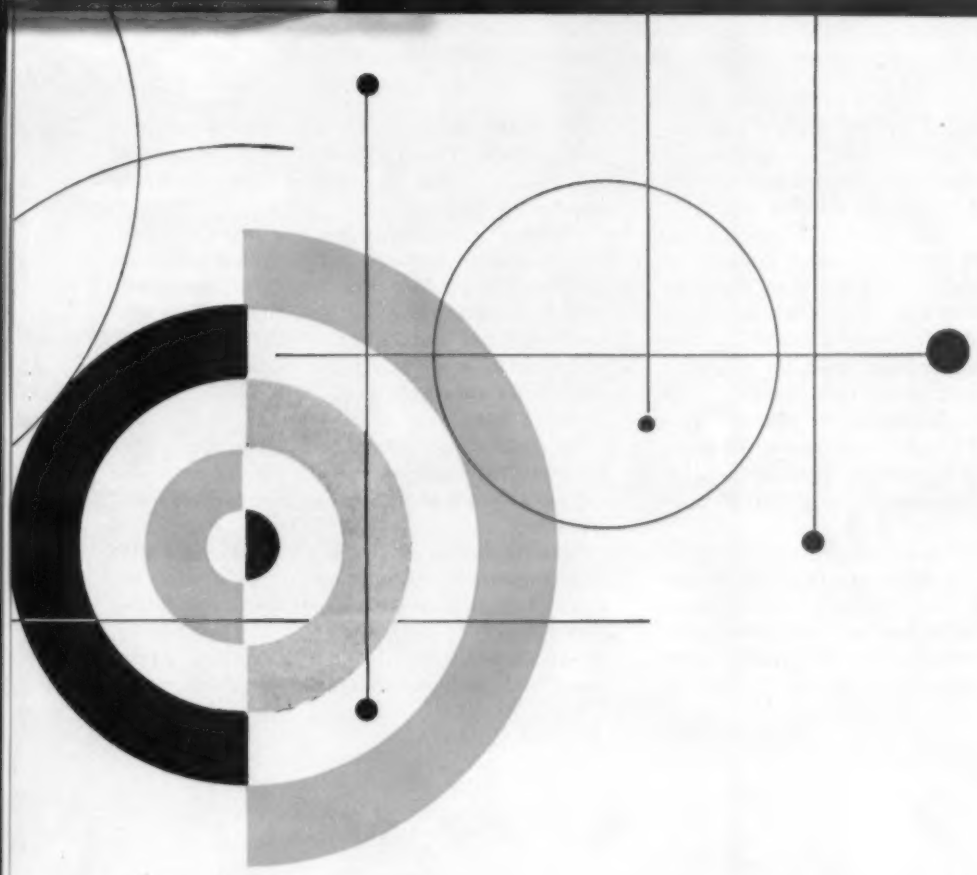
Submerged arc welding will include many more applications closely approaching the fully automatic type. Rates of metal deposition with all fusion processes will continue to increase gradually and generally. Welding will simplify the assembly of many new products; other products will be redesigned specifically for welding. More metals and alloys will be made available in welding grades.

The greatest advances in metal arc welding are most likely to come in the field of electrodes. Ways will probably be developed to use iron powder in electrode coatings so as to obtain welds of the highest quality, yet retain the present advantages of this type of coating. These coatings give a high rate of metal deposition and reduce the amount of effort and skill required of the operator.

Among the fusion welding processes, inert-gas-shielded metal arc welding probably has the brightest future. Commercial use of carbon-dioxide as a shielding gas for welding carbon steels, stainless steels and nickel alloys will place this process in a competitive position with metal arc and submerged arc welding. There will also be an expansion in the use of mixed gases for special effects.

Nitrogen will probably come into wider use as a shielding gas for welding copper. There will be more instances where welding rod is mechanically fed into the tungsten arc for those applications requiring filler metal. The flexibility, ease of application and lack of spatter inherent in tungsten-arc spot welding will broaden the use of this process generally.

Now that techniques and equipment have been developed for submerged arc welding in



the vertical and horizontal positions, its use for large field-erected structures will be accelerated. This practice not only reduces costs, but provides a greater degree of uniformity both in terms of quality and appearance over manual welding.

There will also be more applications employing multiple electrodes to obtain higher rates of metal deposition. Greater use of manual equipment should increase process flexibility considerably, making it more adaptable to a greater variety of work. As suitable fluxes are developed, the process will be applied to a longer list of metals and alloys.

Resistance welding probably claims more fully automatic applications than any other welding process. It promises to hold this position in the future. More three-phase, alternating-current will be used for the aluminum alloys and thicker sections of steel, but single-phase equipment is expected to dominate this field for some time.

One solution to the power supply problem seems to be in the greater use of "series" spot welding. Simplification of electronic control equipment will make it less costly without sacrificing its dependability. Recent research also points to refinements both with respect to equipment and techniques. Recent work on flash-butt welders will result in improved models.

The so-called minor welding processes will still retain a very prominent position in the industry. Oxyacetylene welding shows every prospect of holding its place as the "jack-of-all-trades" for a long time to come. Even in this field, there are rumors of something new. Stud welding has an enormous area for growth both in manufacturing processes and construction.

Cold welding, a relatively new process by which strong joints can be made through the use of pressure but without heat, offers limitless opportunities in the assembly of metal parts. Welds are made easily, quickly, at low cost and with simple equipment in a number of ductile materials including aluminum and its alloys, nickel, zinc, cadmium, lead, copper and silver, plus metals with different hardnesses.

New techniques brighten prospects

In addition to butt and seam welding, techniques developed more recently will have application in an increasing number of metalworking plants. With further development, the process will encompass more weldable metals and alloys, and larger cross-sections will be welded.

Intensive research on electropercussive welding should help to put this process to greater use. It is fully automatic and great numbers of

welds can be made in a short time. These advantages make it an extremely useful process for high-speed production of small parts.

Two new developments in welding will bear careful watching. One is an arc process employing wire with a flux core and a shield of inert gas to protect the weld zone from atmospheric contamination. The other is also an arc process, but in this case a coating is applied to the bare electrode wire by magnetic means just before it is fed into the arc. Both processes have the essentials for fully automatic operation. Although these processes show promise of making notable contributions to welding, both are too new to justify predictions as to their future value.

In another field, the ingenuity and inventive genius that brought fasteners from the blacksmith shop to the 2500-per-minute era still is at work developing new types and new production methods. For example, one bolt maker now under consideration will produce bolts cold up to 1½ in. diam and 10 in. long. Floor space for the machine and its auxiliaries extends to a length of 125 ft.

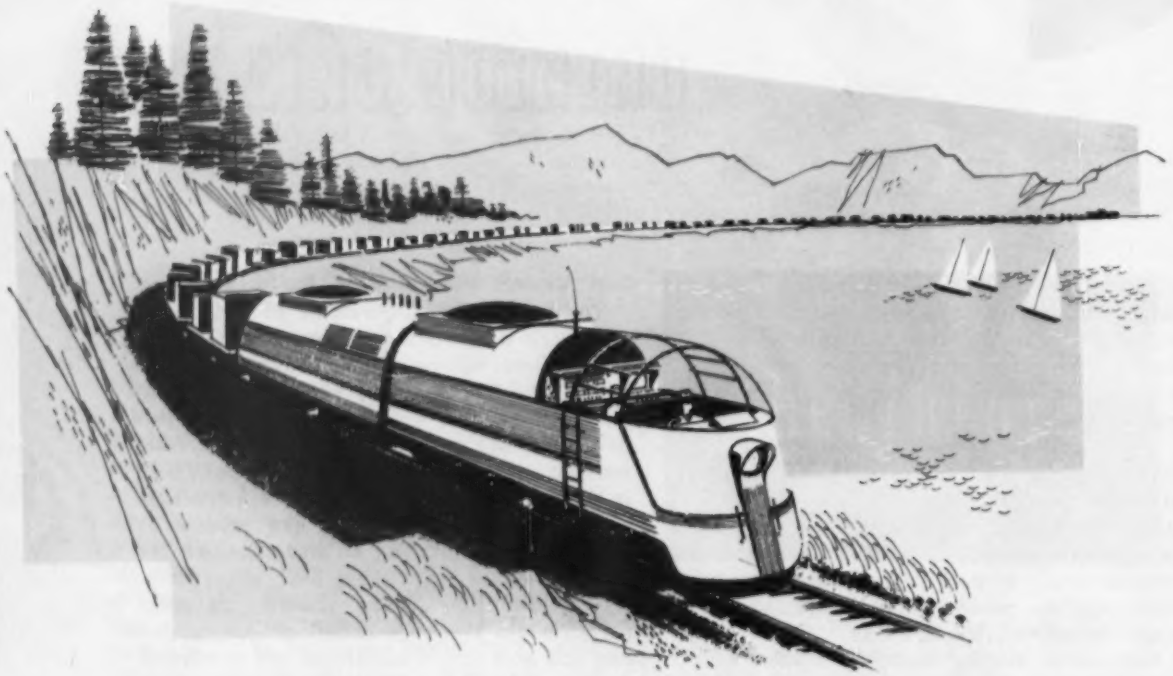
Increased use of automatic assembly by power drivers is another expected development. These units, which deliver the fastener to the screw head without being touched by the operator, contribute considerably to lowered assembly costs.

The future in the construction field seems bright for high strength structural bolts. Several building codes now permit bolting instead of riveting. It is likely, too, that others will soon follow. There may also be an increasing trend to use bolts in place of shop riveted or welded joints.

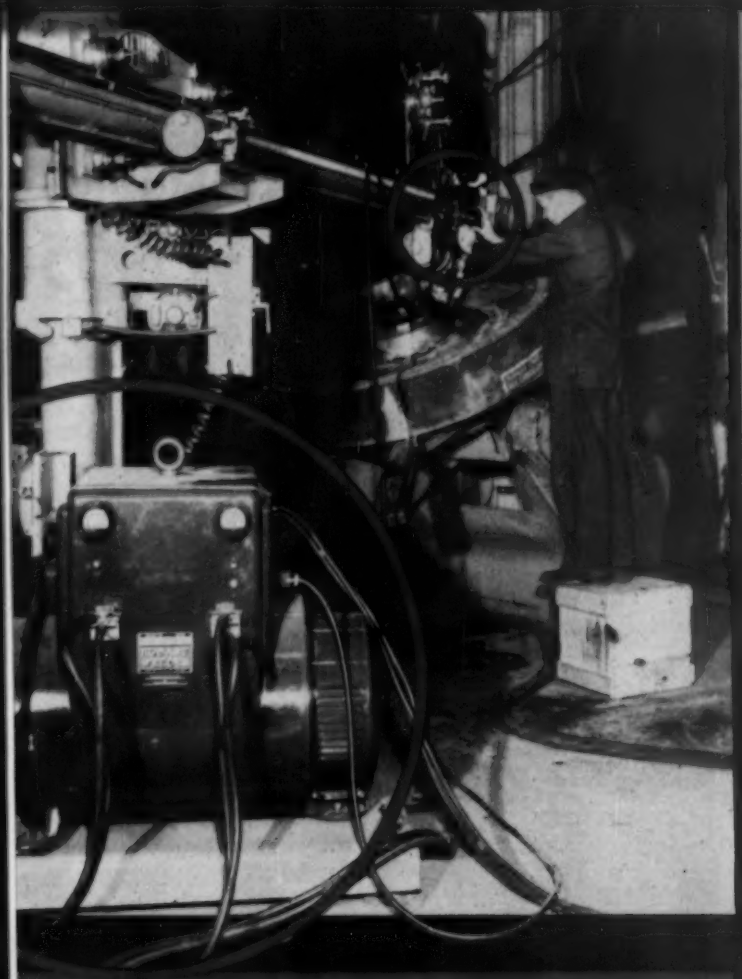
The high-strength bolts offer more economical structural work. In addition, they eliminate fire hazards, reduce the needs for equipment and scaffolding, give uniform and reliable connections, and reduce noise. Bolts now show comparable or slightly lower installed cost, but they could gain even more with an overall rise in labor costs.

In applications other than structural, higher strength fasteners now under development also should contribute to greater compactness and efficiency.

Manufacturers of industrial fasteners also look forward to the production of a wide variety of special hot and cold headed parts. These items may not be fasteners, but they can be produced economically on bolt making equipment with savings of material and cost.



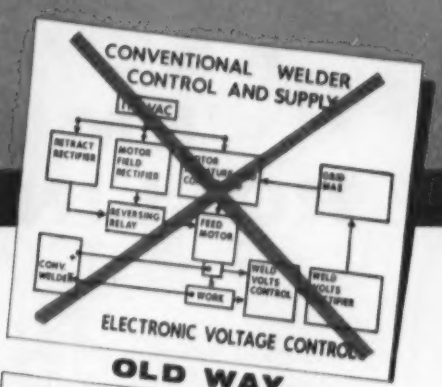
WELDING will play a large part in railroads of the future. From the engine to the caboose, the railroad is probably representative of more forms of welding than any other type of structure. Whether the job will involve joining high-temperature components of a nuclear power-driven engine, or the hair-like elements of sensitive electronic devices, the welding industry is prepared with a process to accomplish it quickly, efficiently and effectively. It will be equally well prepared for every industry where metals are to be joined.



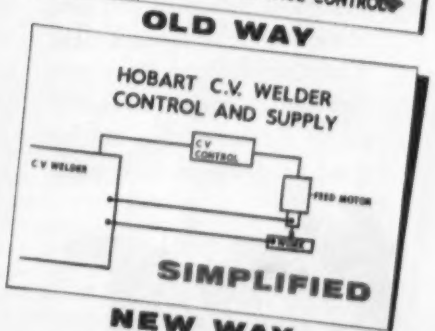
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OLD WAY



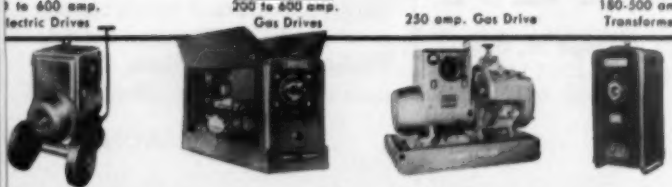
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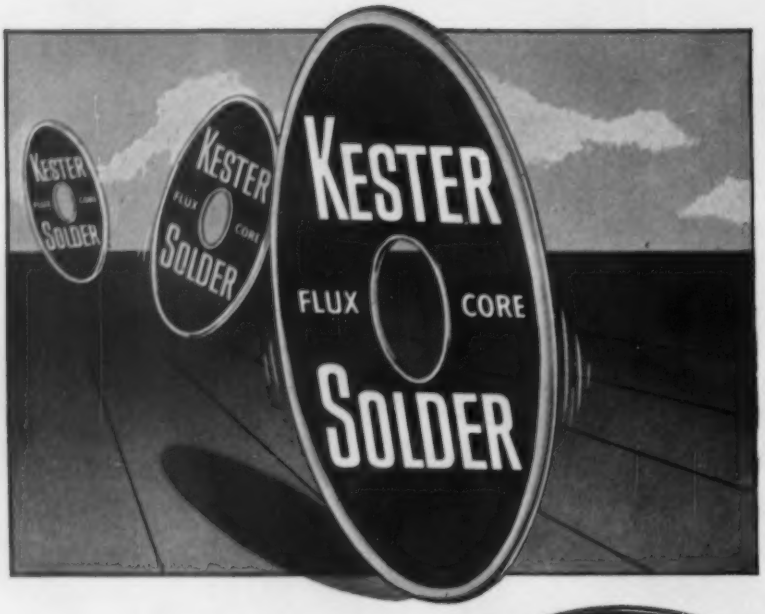
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Quotes: 1855—1955

Abstracts from past issues of THE IRON AGE, *selected for their flavor, and with some regard for whimsy:*

Suggests Welded Ships

A mechanic in Philadelphia proposes to build steamships of one solid piece of iron or steel, without seam of joint. This he accomplishes by welding the plates and frame instead of using bolts or rivets. He claims that he has invented machinery by which the thing can be done, at a great saving of cost, of weight and of time, and with a great gain of strength and durability.

Jan. 5, 1873

Arc Welding Cuts Costs

A plant in which marked results in production work including lower costs have been obtained by the use of arc welding is that of the Lincoln Electric Co., Cleveland, which is using welding wherever it is applicable in the manufacture of electric motors, for welding both steel and copper parts and in assembling work. The number of welding operations that this company is doing in constructing motors may be taken as illustrating, perhaps, what the welding process offers to manufacturers of other lines of equipment.

July 9, 1925

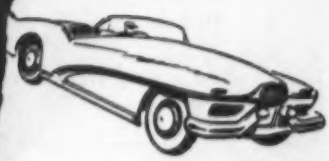
Welded Electrically

Return bends for superheater units are being welded by electricity in the Mont Clare shops of the Baltimore & Ohio Railroad, Baltimore, in accordance with a method developed by the Thomson Electric Welding Co., Lynn, Mass.

Dec. 3, 1925







RB&W salutes IRON AGE on its 100TH ANNIVERSARY

We've come a long way together

Back in 1859 when we were quite young — just 14, to be exact — this RB&W ad appeared in IRON AGE. IRON AGE was going strong . . . while RB&W was paving the way for mass production of bolts and nuts with the invention of the world's first cold-heading machine.

A lot of changes have taken place since then. From the tiny room in a button factory at Pemberwick, Conn., where the first fasteners were made, RB&W has expanded to four streamlined plants at Port Chester, N.Y., Rock Falls, Ill., Coraopolis, Pa., and Los Angeles, making a complete line of bolts, nuts, screws and rivets.

The carriage bolts we were so proud of in 1859 have been joined by thousands of other standard and special headed and threaded products to meet the needs of the automotive industry, and other metal-working manufacturers. But even after a century of progress, we can't improve on the words in our 1859 ad: "Uniformity of size, accuracy of fit in the threads, and general finish cannot be equaled."

Looking back, we're equally proud of the long and friendly association with IRON AGE which has helped us keep in step with our customers down through the years. 4.46

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Plants at: PORT CHESTER, N.Y.; CORAOPOLIS, PA.; ROCK FALLS, ILL.; LOS ANGELES, CALIF. *Additional sales offices at:* ARDMORE (PHILA.), PA.; PITTSBURGH; DETROIT; CHICAGO; DALLAS; SAN FRANCISCO. *Sales agents at:* NEW ORLEANS, DENVER, SEATTLE. *Distributors from coast to coast.*

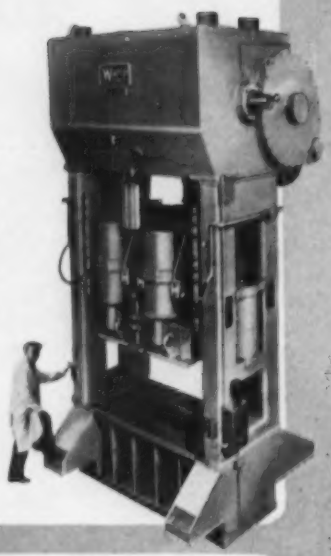
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Federal WELDERS

Federal Builds a complete line of standard and special high speed, automatic resistance welders—spot, roll spot, projection, flash butt, seam—portable, press or bench types—air, motor or hydraulic operated—single or three phase of any KVA rating. In fact, the resistance welder had its beginning at Federal, and today, more Federal welders are at work in the nation's plants than any other make. That's why, when considering new equipment—it pays to talk with FEDERAL—FIRST IN RESISTANCE WELDING.



Federal WELDERS
Warco PRESSES

The Federal Machine and Welder Company
WARREN, OHIO

QUOTES: 1855—1955

Welded Fenders Prove Practical

With the development of sweeping fender lines, with deep crowns and long skirts, on its six-cylinder and eight-cylinder passenger cars, the Pontiac Motor Co. is finding it more economical and practical to make its front fenders in two pieces welded together rather than in one piece stamped out of a single steel sheet. Probably the outstanding achievement in connection with this job is the butt flash welding of the outer and inner sections of the fender, each 90 in. long, the welding being done with such perfection that the flash or burr is ground off and prepared for the enamel coat without any soldering being necessary.

July 11, 1935



Bettmann Archive

TESTING wire to be used in bridge-building. About 1880.

Zinc Ammonium Chloride Use in Galvanizing

There is considerable merit to the use of zinc ammonium chloride in the galvanizing of pipe. First, a tangible reduction in dross is obtained by the elimination of hydrochloric acid in the "bosh" tank. Second, there is with its use as a solution a thorough fluxing of material, whereas it is impossible to conceive of several or more pieces of pipe, ½ in. O.D. or even larger, by 30 ft. long, receiving a thorough

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Save cost of tapping and tap equipment



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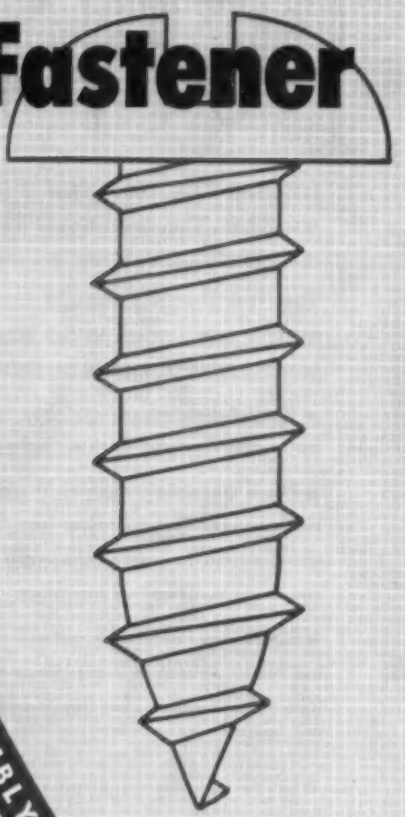
Save cost of inserts for machine screws in plastics



Permit extra speed of power and automatic driving



Permit simpler design — fewer fastenings



ASSEMBLY COSTS STAY DOWN

PLAN FOR LOWER COST

from savings like these and from many more assembly advantages of Self-tapping Screws . . . then

PURCHASE TO *KEEP* COST DOWN

Insist on *P-K quality* to guard against screw failure and loss of most planned savings. Screw faults are hard to detect, but cost sheets and customer complaints soon show their effects — job slowdown, parts damage, high reclamation costs, loosening under vibration, hidden weakness.

P-K QUALITY STANDARDS PROTECT YOU

against "softies," and "cripples," — any defective screws. That's why *all* P-K Screws you get can be *Guaranteed First Quality.*

IN STOCK
See your P-K DISTRIBUTOR

PARKER-KALON®



Remember . . . for screws that START RIGHT . .

IDEA of the CENTURY

In the past hundred years, the one revolutionary idea in threaded fasteners was pioneered by Parker-Kalon . . . hardened Self-tapping Screws.

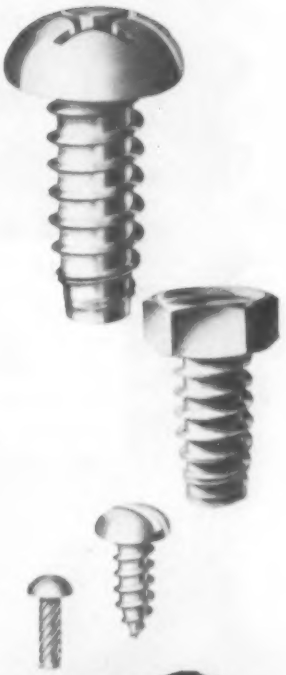
They offered simplicity, speed, and security for fastenings to metals, plastics, laminates, — savings impossible with conventional methods. They inspired the modern assembly techniques essential to mass production. Their contribution to cost reduction mounts by millions every year.

For almost any assembly, there's a big potential saving with Self-tapping Screws. But the promise can fade in production if screw failure snarls up the line. That's why quality standards for P-K Self-tapping Screws were set so high to begin with, and are still harder to match today.

Only Parker-Kalon can offer P-K quality, the indispensable extra, along with the proved advantages of Self-tapping Screws.

Only Parker-Kalon can offer P-K experience — covering many more years and millions more applications than any comparable record.

Plan your assemblies for lowest cost . . . a P-K Assembly Engineer will help you. Then make sure *planned* savings keep on *paying off* . . . when you purchase, order "P-K". Parker-Kalon Division, General American Transportation Corporation, 200 Varick St., New York 14.



The First originated by P-K . . . and *first* today . . . the leading choice for fastening economy

SELF-TAPPING SCREWS





. . DRIVE RIGHT . . . SEAT RIGHT . . . STAY TIGHT . . . P-K means OK



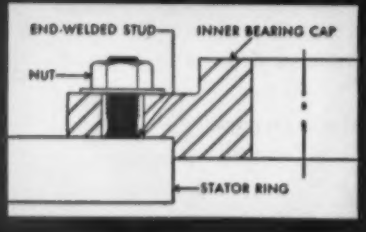
"STUD" NELSON ATTACHES

SUB-ASSEMBLIES IN A FLASH!

Easy does it . . . a NELWELD® gun makes the placing of attachment studs a simple operation . . . takes the tool to the work . . . cuts costly material handling . . . eliminates drilling and tapping.

Studs stay put! . . . NELSON® welded studs fuse with the parent piece to become an integral unit, equally strong at the weld.

Trigger fast, too! . . . push a button and you've got a weld.



. . . just a few reasons why the NELWELD system is the practical way to attach fixtures, brackets, bearings, accessories, pillow blocks, and endless sub-assemblies.

A corps of Nelson experts is trained to help co-engineer better fastening with inevitable cost reduction. And the Nelson network of factory warehouses blankets the country . . . puts studs, equipment, and rentals right in your own back yard! Write for details.

Stud Nelson

Fasten it Better at Less Cost with

NELWELD

NELSON STUD WELDING
2737 Toledo Avenue
Lorain, Ohio

Please send more information on stud welding sub-assemblies and other applications.

NAME _____

COMPANY _____

ADDRESS _____

CITY AND STATE _____

NELSON STUD WELDING DIV. OF GREGORY INDUSTRIES, INC. **LORAIN, OHIO**

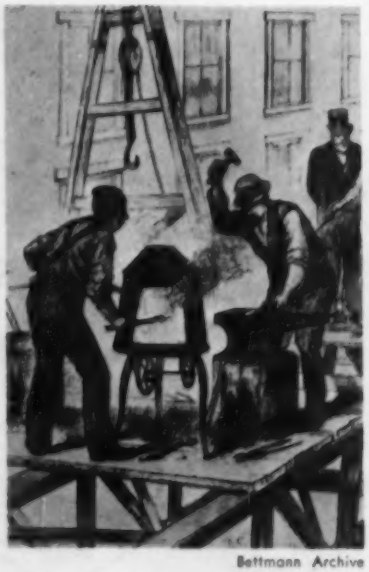
fluxing on the inside while being forced *en bloc* through a deep and viscous volatizing flux.

For an operation of this nature a cold solution is the only practical one, due to the compactness of a large and heavy lift of pipe with the consequent impossibility for each piece of pipe to become thoroughly dried inside and outside by the heat absorbed from any hot rinsing and fluxing solution into which the lift might be immersed. Likewise an immense "hot plate" surface area would be necessary if one could be used to assist in this drying and preheating.

Must Drain Pipes

The use of a cold solution requires that each lift of pipe be drained thoroughly when removed from the pickling tank and again when taken from the rinse tank, so as to minimize the acid "carry-over" and dilution of the fluxing solution. At the same time speed is essential during these two periods of draining in order to get the lift into the solution before oxidation sets in.

H. G. Hobbs
July 18, 1935



Bettmann Archive

SMITHS working on elevated railroad in New York about 1878.

Galvannealing Provides Uniform Zinc Coating

So far as the writer J. L. Schueler) is aware, "galvannealing" involves the only basic change which has been made in hot zinc-coating since Meloun developed the first process in 1742. The galvannealing process is identical with the ordinary hot zinc process up to the point where the wire leaves the molten zinc, but from there on the processes differ radically, because in the galvannealing process the coated wires are not wiped, being immediately passed into a heat-treating furnace, the heat-treatment not only smoothing the coatings, but also making them flexible and malleable.

Wire Must Be Clean

In the description of the process which follows, each step of zinc-coating wire is considered. The wire passes from the reels into a bath of molten lead maintained at approximately 1300 deg. Fahr. (705 deg. C.) for the purpose of removing the hardness caused by wire drawing. After leaving the annealing furnace the wire travels through the air for a distance of about 90 ft. (27 m.), thus giving it time to cool at a relatively slow rate. (We are speaking now of the ordinary soft steel used for fence wire or barbed wire. If high carbon wires are used, then the essence of the process is the same, but the details such as temperature of annealing, method of annealing, cooling and so on, are different.)

Heated to Dry

The wire then enters a bath of commercial hydrochloric acid (muriatic acid) so as to thoroughly clean the wire surface. This cleaning is very important; in fact, it is the essence of any coating operation, as dirty surfaces cannot be coated. The wire when leaving the acid bath is very wet, and before entering the molten metal should be dried. This is done by passing the wire over hot iron plates.

July 9, 1925

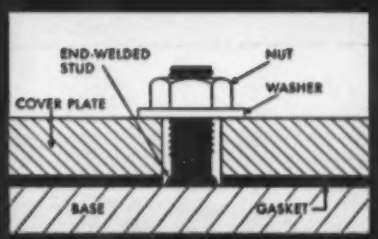


"STUD" NELSON SECURES

COVER PLATES IN A FLASH!

Pfft! A split second with a NELWELD® gun and you've got a sturdy end-welded stud right where you want it . . . ready to line up with the cover plate hole. That's real speed!

Multiply the saving in time by the number of fastening locations on your product. Add what you save by eliminating drilling and tapping; then figure the heavy bosses you won't need.



NELSON® studs . . . used to hang, handle or hold . . . come in many shapes, types and sizes.

Nelson Field Engineers, all cost-reduction specialists, operate from a nationwide chain of field offices and warehouses. They're trained to efficiently handle all your needs for studs, equipment, or fastener engineering. Write for details.

Stud Nelson

Fasten It Better at Less Cost with

NELWELD

NELSON STUD WELDING
2735 Toledo Avenue
Lorain, Ohio

Please send more information on cost-saving stud welding applications.

NAME _____

COMPANY _____

ADDRESS _____

CITY AND STATE _____

NELSON STUD WELDING DIV. OF GREGORY INDUSTRIES, INC. LORAIN, OHIO

Carries Voice Well

At a recent meeting of the Paris Academy, M. Paul Bert described a telemicrophone, which transmits speech well, though spoken to at some little distance. In it two important modifications of the ordinary apparatus are introduced. The first consists in the substitution of a comparatively thick plate of hardened rubber for the thin membrane commonly employed; the other is a new way of regulating the carbons of the microphone.

The fixed carbon passes through the plate; the other is carried by a small pivoted rod of iron, the mobility of which depends on the position given to a small magnet, which forms part of the mechanism.

Simplicity, Precision

The author recommends the simplicity and precision of this mode of regulation as much preferable to the various kinds of springs hitherto proposed. It need hardly be added that the variations of current produced by the vibrations are transmitted to a suitable receiver.

The disturbing microphonic sounds are avoided in the new instrument, and the voice, far from having the disagreeable timbre of most telephones, is hardly altered. Speaking (pretty loudly) at a distance of even four or five meters from the vibrating plate there is perfect transmission.

May 6, 1880



Bettmann Archive

VIEW IN TINNING house as shown in woodcut of about 1896.

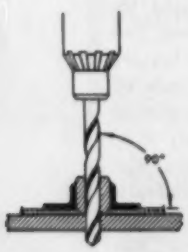


Bettmann Archive

MINING bathhouse at Leadville, Col. with hot water via teakettle.



Free hand drilling of perpendicular holes using Anchor Bushing Drill Template at Ryan Aeronautical Co., San Diego.



ANCHOR BUSHING DRILL TEMPLATE — DRILL SUPPORTED AT LOW COST.



UNBUSHED DRILL TEMPLATE FOR LOW VOLUME PRODUCTION — NO DRILL SUPPORT.

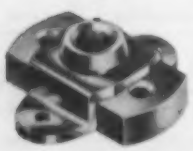
AVOID WORK SPOILAGE—USE ANCHOR BUSHING DRILL TEMPLATES

Rejects threaten when unbushed drill templates are used to replace expensive drill jigs or fixtures on small quantity production runs.

Being low in cost and easy to make, Anchor Bushing drill templates prevent off-perpendicular drilling, inaccuracies of hole location and the use of wrong drill sizes.

Anchor Bushings are riveted or spot-welded to sheet metal, and riveted on or imbedded in laminated plastic materials. These lightweight drill templates can be made flat or in compound curves for a fraction of the cost, time and skill required for drill jigs or fixtures.

Learn how to make low cost, accurate drill tooling — write for the Anchor Bushing Catalog.



FAITPLATE ANCHOR BUSHING



STANDARD ANCHOR BUSHING

hi-shear RIVET TOOL COMPANY

8924 BELLANCA AVE., LOS ANGELES 45, CALIFORNIA



B-RIGHT-ON®

SOCKET SCREW PRODUCTS

always measure up!

QUALITY ★ B-RIGHT-ON ® PRODUCTS

Socket screw users who want *what* they want *when* they want it know it pays to specify B-RIGHT-ON! Brighton Socket Screw Products *always* measure up.

Standard or special, Brighton Screws must meet and pass factory standards that are higher even than those specified by the ultimate user of the screws. Rigid control, from initial steel selection to final packaging, certifies every screw as B-RIGHT-ON quality.

Selected mill supply houses, Brighton distributors, complete the control chain, assure the user of service and delivery as dependable as the screws . . . B-RIGHT-ON service.

Write for descriptive literature . . . see how

YOU CAN DO BETTER WITH B-RIGHT-ON.

THE BRIGHTON SCREW & MANUFACTURING CO.

1829 READING ROAD CINCINNATI 2, OHIO

ARCOS FOR FINEST QUALITY WELDS



Submerged Arc Welding of Stainless with new Arcosite Flux

Now, for the first time, you can apply the economy of submerged arc welding to stainless steels. No longer need you worry about cracking, or poor transfer of the essential stainless elements. The combination of *new* ARCOSITE FLUX and *new* ARCOS CHROMAR (Stainless Steel) WIRE provides a balanced analysis for sound, dependable welds on every job. It's another example of how Arcos experience with coated electrodes and weld metallurgy is being translated into tangible benefits for you.

Write today for the Arcosite Flux Bulletin and see how you may profit from these two *new* Arcos products. Arcos Corporation, 1500 South 50th Street, Philadelphia 43, Pennsylvania.

WELD WITH ARCOS

STAINLESS WIRE AND ARCOSITE FLUX

Discover Ohio Iron

A sixteen foot vein of iron ore has been discovered in Adams township, Guernsey county, Ohio. The vein discovered is just over the Muskingum county line, and the people of Highland township, Muskingum county, claim that the same vein runs into their own territory. The ore is said to contain sixty-five per cent metallic iron, which, we presume, is an exaggeration.

Apr. 17, 1873

Credit Interchangeability To American Mechanic

The American manufacture of implements and smaller machines owes its superiority, not only to a larger use of machine tools, but to an idea more important in its result than any merely mechanical invention, and one which is unquestionably of American origin. This idea is, the making each of the several parts of many different machines interchangeable.

For instance, in making a number of muskets, the manufacturer does not fabricate each musket separately; but he constructs each of the smallest pieces of 10,000 muskets, it may be, separately, and makes them so precisely alike that each will fit exactly any one of the 10,000 muskets. Under this system a machine tool moved by power is adapted for each operation; one tool cuts 10,000 slots continuously, another drills 10,000 holes, and so on. By this means there is attained not only extraordinary precision, but great economy in production.

Employed At Armory

The name of the inventor of this, perhaps the greatest of all American inventions, but one which from its nature could not be secured by patent, is hardly known out of his own town; and the object of this note is to place it on record. In a recent conver-

sation with a gentleman formerly in the United States Ordnance Corps, and now at the head of the largest manufactory of arms in the world, that gentleman stated to us the following:

The author of the invention of the system of making the parts of machines interchangeable was, or rather is—for he is still living at an advanced age—a mechanic named Thos. Warner, employed in the United States Armory at Springfield, Mass.

Called Impractical

When he first suggested his idea to the Ordnance Bureau at Washington, it was pronounced impracticable, not only by the bureau, but by practical mechanics generally. He persisted until the experiment was tried in the construction of arms at Springfield. The success finally obtained at Springfield led to the introduction of the system into all the factories of arms in the country, public and private. From thence it was applied to the manufacture of sewing machines, watches, and all small machines made in numbers and consisting of many parts.

It is this system which makes it possible for a single factory of arms in this country to make more muskets in a day than can be made in all England in a month. It is this which enables us to supply all Europe with arms and to export sewing machines to all the European nations, notwithstanding the vastly higher cost of our labor.

Apr. 24, 1873

Dakota Tin Mines

The wonderful tin mines of Harney Peak, Dakota, have not yet upset our local markets by a flood of American tin. While there seems to be little doubt that there is tinstone there in paying quantities, the production is not got out with the rush which ardent promoters would like the public to believe.

ARCOS FOR FINEST QUALITY WELDS



Mountains crumble as ***welded*** *jaws bite in*

Modern power shovels gulp truckloads of rock and dirt at one bite. It's a good example of how *welded* high tensile steels make possible bigger payloads—provide extra strength and toughness to reduce maintenance.

An important factor in this achievement is the quality of weld metal. That's why so many fabricators today specify Arcos Low Hydrogen Electrodes when welding low alloy high tensile steels. *On any job* demanding shock and abrasion resistance . . . maximum strength and ductility, the excellent properties of Arcos weld metal assures the results you want in service. Arcos offers quality weld metal and technical assistance that is second to none. Arcos Corporation, 1500 South 50th Street, Philadelphia 43, Pa.

WELD WITH ARCOS LOW HYDROGEN ELECTRODES

It is one thing to promise tons of metal a day, and quite another thing to do it. Assuming that the tinstone carries 2 per cent of metal, an output of 1000 tons per annum would call for the crushing of 50,000 tons a year.

Remote Area

In a locality remote from railroads it takes time to provide the machinery for such an amount of work, and the owners of the deposits have not yet even made up their minds what to order and from whom. We question, therefore, whether Dakota tin will appear in our markets in any quantity worthy of notice in the year 1885.

As for the wild and extravagant statements that we are to be made independent of foreign supplies at an early date, they are simply absurd. We use about 12,000 tons per annum. It would take years to get mines, if they could stand the strain, and plant into shape for such a quantity.

May 7, 1885

HERE ARE THE NEW

MID-STATES *Viking* Heavy Duty Industrial AC and DC ARC WELDERS



Select from the Complete MID-STATES Line

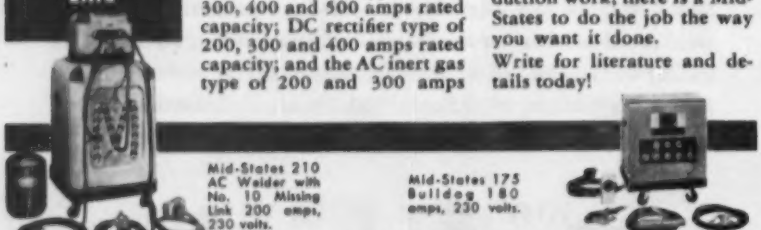
Something new and big has been added to the Mid-States Welder line: the New Mid-States Viking AC and DC industrial-duty arc welders . . . proved in performance and recognized for their fine quality.

Mid-States Viking Welders are available in three types to suit every industrial welding purpose:

AC transformer type of 200, 300, 400 and 500 amps rated capacity; DC rectifier type of 200, 300 and 400 amps rated capacity; and the AC inert gas type of 200 and 300 amps rated capacity. The Mid-States Vikings have patented features, unique design and a sturdy construction.

And in the well known Mid-States Welder group of lower amperage units there are sizes ideal for shop use—ranging from 7 to 300 amps capacity. Whatever your arc welding problems may be, light or heavy duty, general or production work, there is a Mid-States to do the job the way you want it done.

Write for literature and details today!



Dealers invited—some good territories open—write for details.

Mid-States WELDER MFG. CO.

6025 SOUTH ASHLAND AVENUE • CHICAGO 36, ILL.

Heat Treater's Art

To be able to properly temper steel springs and implements may be considered a gift similar to that possessed by the "poet born."

Applied to Springs

A man whose business in a certain tool-shop was to temper springs worked 22,000 consecutively, and of the whole number only six failed to pass the test; but during his temporary illness more than half the springs handled by his assistant, who had been under instruction a year, failed. In a large manufactory of sword blades one man does all the tempering, being called in from other employment at intervals, because, although he has always been willing to instruct others, he has never had a pupil who could equal him in the work.

President Handles Job

There is a large scythe manufactory in a New England town making 14,000 dozen scythes a year, and the president of the company has for years hardened and tempered every scythe that leaves the works, because no other man in the works can do it so well.

May 7, 1885



Bettmann Archive

CHIPPING boiler with a pneumatic hammer. From an 1889 engraving.



EATON-RELIANCE

Industrial fasteners help produce these products (and many more)

BETTER, FASTER and for less!



Eaton Standard Springtites and Sems speed production by combining spring washer and bolt or screw into one easily handled part. Engineering Bulletin S-49 has all the details.

Reliance Spring Lock Washers, available in all types, sizes and analyses, keep bolted assemblies *tighter longer.* For complete lock washer information, write for Engineering Bulletin W-50.



Eaton Thread-Cutting Springtites and Sems eliminate tapping when fabricating products. They cut their own threads as they fasten assuring perfectly mated, tightly seated threads. Full information in Engineering Bulletin S-49A.



Reliance Cold Finished Steel is available in rounds, squares, flats or special shape sections in wire sizes .020 x .020 x ½ to ⅝ in coils or cut to length. Write direct for information on sizes, shapes and analyses.



Reliance Hoz-Fas-Ners save time and money wherever rubber, plastic or fabric hoses are used. Rust resistant, re-usable, one piece design . . . maintain uniform automatic tension. Write for Engineering Bulletin No. 1.



Reliance Snap Rings save man hours and material on shaft assemblies, bearing applications and in counterbore assemblies. Shoulders quickly formed by machining a groove and snapping in a Reliance ring. Send for Bulletin 4K/3.

"SPRINGTITE" AND "HOZ-FAS-NER" ARE REGISTERED TRADEMARKS OF THE EATON MANUFACTURING COMPANY.

RELIANCE DIVISION EATON MANUFACTURING COMPANY

Springtites & Sems · Snap & Retaining Rings · Special Steels · Spring Lock Washers · Hoz-Fas-Ner

OFFICE and PLANTS: 550 Charles Ave. MASSILLON, OHIO

SALES OFFICES: New York • Cleveland • Detroit • Chicago • St. Louis • San Francisco • Montreal

June, 1955

L-31



THE REVOLUTIONARY NEW WAY TO CUT AND GOUGE ALL METALS!

ACTUAL case histories prove the Arcair torch is faster, cheaper and gives better work, on metal cutting and gouging operations. Here are a few of the amazing savings effected by the Arcair method in industry. . . . "Arcair torch cuts assembly time 20% in fabricating steel tanks. . . . Foundry reports 25% reduction in casting cleaning time with Arcair torch. . . . Arcair torch is 80% faster in gouging and cutting refinery tanks. . . . Arcair torch cuts labor costs 80% in removing old welds."

The Arcair process is based upon the melting action of an electric arc, combined with a jet of compressed air constantly directed at the point of arc. Slag and molten metal are blown away before they can harden, leaving a clean, even groove or cut. The operator has complete control over the gouging action to such an extent that little or no grinding is required to finish up the gouging or cutting job. To realize the full performance and economy designed into the Arcair torch, GENUINE ARCAIR ELECTRODES, either plain or copper-coated, should be used.

Write TODAY for your FREE copy of "The Arcair Case History Booklet", containing complete details of the case histories mentioned above, plus many others.



ARCAIR COMPANY
443 South Mt. Pleasant Ave., Lancaster, Ohio

Wire Nail Pioneer

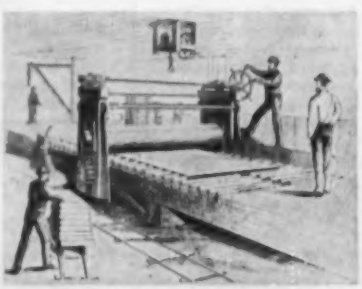
Mr. William Hassall, 63 and 65 Elizabeth street, New York, enjoys the distinction of being the pioneer wire-nail manufacturer in this country. Mr. Hassall started business in 1850 with five wire-nail machines of his own construction. The machines in use abroad were what are known as the German machines, but Mr. Hassall's were distinctly American, and quite different from the older types. In his shop at present some 34 machines in all are in operation, and their product includes American and French wire nails, from 1/32 inch to any length, with flat, round, oval, depressed, screw and fancy heads, besides cigar box, molding, finishing and various other kind of nails. Mr. Hassall has recently made some improvements in his machines which add largely to their efficiency. The wire-nail industry has already assumed considerable proportions, and its products are being used for various purposes.

May 21, 1885

Will Make Locomotives

The manufacture of locomotives has been commenced at Rome, Ga., by Messrs. Noble. The Georgia railroad managers are models of sagacity, prudence, and honesty. The roads are all owned in the State, and free from debt.

June 18, 1856



Bettmann Archive

ROLLING MILL for lead used in shipbuilding, as it looked about 1878.



WHEN IT'S *Special* BOLTS *and* STUDS

Send your Specifications to

ERIE

40 years' experience in making special bolts, studs, nuts for specific job requirements.



REPRESENTATION IN PRINCIPAL CITIES



Quality...
Performance...
Durability...

Victor presents . . . **8 completely new cutting torches**

Models ST-1000, ST-1100, ST-1200 and ST-1300 Hand Cutting Torches . . . Model CA-1050 Hand Cutting Attachment . . . and Models MT-200 and MT-300 Machine Cutting Torches.

These completely new designs feature modern-clean-streamlined-sturdy lines . . . stainless steel preheat gas mixing chambers . . . heads of forged Everdur bronze or Monel . . . valve bodies and "Y's" solid die forged brass . . . hand-fitting oval shaped fluted brass handles . . . choice of cutting oxygen lever in four locations, top and bottom, front and back.

VICTOR Quality Cutting Torches will do a better job and stay on it under all kinds of difficult cutting operations.

VICTOR
for welding

VICTOR EQUIPMENT COMPANY

Mfrs. of welding & cutting equipment; hardfacing rods, blasting nozzles; cobalt & tungsten castings.

844 Folsom St.
San Francisco 7

3821 Santa Fe Avenue
Los Angeles 58



Get Airco Inert-Gas Welding into your Production Picture!

Lower costs through quality and speed . . . that's Airco's answer to your production problem – even when the materials include aluminum, bronze, copper, nickel, stainless steel . . . all engineering metals.

The Aircomatic welding unit, for example, was researched and designed by Airco to produce top-quality welds . . . especially in "problem" metals and alloys without flux . . . with minimum plate edge preparation and little or no preheat. In performance, Airco's Heliwelding is similar – though engineered for high-speed welding of *thin* sections of metals – any metals.

And with the newest Airco addition to inert-gas-shielded welding, Aircospot, you can weld from one side of the joint – eliminating jigs and backup plates. Aircospot is the perfect primary tool for fabrication and no finer cost-saving tool for tack welding has ever been devised.

You'll want to learn more about how Air Reduction's inert-gas-shielded arc welding processes can serve you. Contact your nearby Airco Representative, Authorized Airco Dealer – or write Airco direct.

WELDING SHOW VISIT BOOTH 254

AIRCO®

AIR REDUCTION

60 East 42nd Street • New York 17, N. Y.

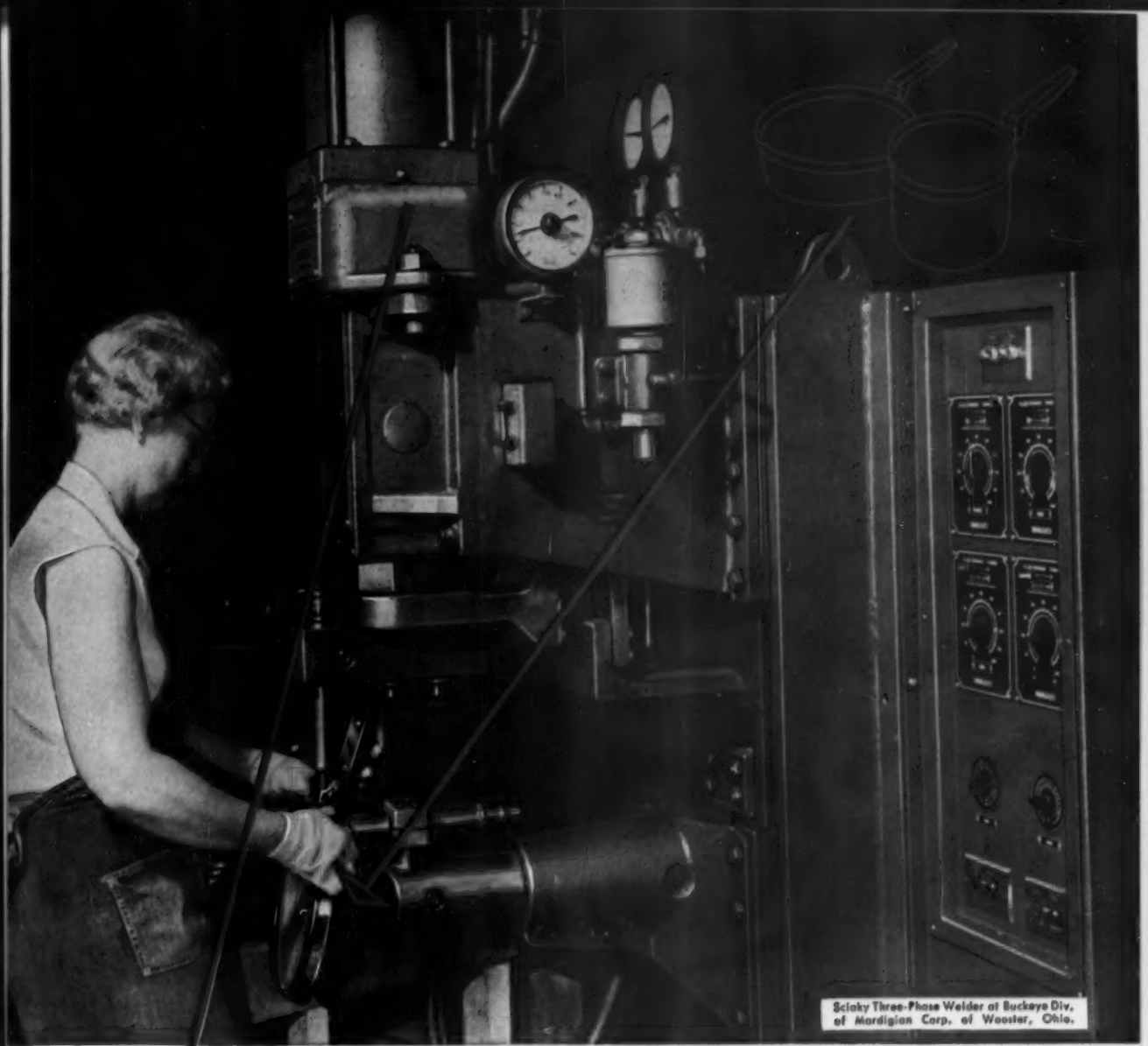
Divisions of Air Reduction Company, Incorporated, with offices in most principal cities

Air Reduction Sales Company
Air Reduction Pacific Company

Represented internationally by Airco Company International

Foreign Subsidiaries:
Air Reduction Canada Limited,
Cuban Air Products Corporation

Products of the divisions of Air Reduction Company, Incorporated, include: AIRCO – industrial gases, welding and cutting equipment, and acetylenic chemicals • PURECO – carbon dioxide, liquid-solid ("DRY-ICE") • OHIO – medical gases and hospital equipment • NATIONAL CARBIDE – pipeline acetylene and calcium carbide • COLTON CHEMICAL COMPANY – polyvinyl acetates, alcohols and other synthetic resins.



Sciaky Three-Phase Welder at Buckeye Div. of Mardigian Corp. of Wooster, Ohio.

PRODUCTION JUMPS 375%...

Costs Cut Sharply with Sciaky Patented Three-Phase Welders

FACTS ABOUT SCIAKY PATENTED THREE-PHASE

	SINGLE-PHASE	SCIAKY THREE-PHASE	SAVINGS
ANSFORMER ATING	250 KVA	100 KVA	150 KVA
ELDING VA DEMAND	650 KVA	325 KVA	325 KVA
NE AMPS PER ONDUCTOR 40 V.	1,476 A.	430 A.	1,046 A.
OWER ACTOR	30%	85%	Greatly Improved
STALLATION OST—EST.	$10,500	$5,250	$5,250

Buckeye, with an enviable 52 year record of manufacturing, uses Sciaky patented Three-Phase Balanced Load, High Power Factor resistance welders extensively in fabricating high quality aluminum kitchenware.

Standard Sciaky Three-Phase Welders increased production 375% over riveting in joining a variety of handle mounting brackets to different size pans. Even beyond the savings in costs of rivets and related tooling, Sciaky Balanced Load Three-Phase with 85% power factor (compared to 30% for conventional single phase) and a 50% reduction in power demand, is far less expensive to operate than conventional single phase *unbalanced load* welders. Sciaky Three-Phase readily solves power problems, and further, installation costs are estimated at only half of single phase installation cost.

Write today for "Resistance Welding at Work", Vol. 4 - No. 2. Read the complete details of Buckeye's impressive application of Sciaky basic thinking—welders designed to do *more useful work* at *lowest operating cost* with *maximum reliability*.

Largest Manufacturers of Electric Resistance Welding Machines in the World

SCIAKY

Sciaky Bros., 4923 West 67th Street, Chicago 38, Illinois

Iron Electrotypes

We take the following from an account of Klein's process of electrotyping in iron: On leaving the bath, the iron is as hard as tempered steel, and very brittle. Reheated to a dull red heat, it loses much of its sharpness and hardness. Heated to a cherry red, it becomes malleable, and may be engraved as easily as soft steel. If the deposits are produced in good condition, and annealed uniformly and with the necessary precautions, they are subject to neither warp nor bend. There is no contraction, but, on the contrary, a slight degree of expansion, almost imperceptible, however.

Owing to the necessity of having bank note and similar plates identical in every respect, it is of the first importance that they should not be distorted, nor have their dimensions altered in the process of annealing. It appears that the galvanic deposit of iron has not only permanent magnetism, but that, like soft iron, it receives the magnetism of position. Of the importance of the practical application of the process there can be no doubt whatever.

Almost Indestructible

By replacing plates of copper by those of iron, greater facilities will be afforded for producing publications, works of art, and especially banknotes and checks. Iron electrotype plates are found to be almost indestructible. They not only can be printed from an almost unlimited number of times, but they are better calculated than those of copper to withstand those inevitable accidents constantly occuring in printing establishments.

Printers are sometimes obliged to set aside as useless their best plates, which are often damaged by a grain of sand or by a chance knot in the paper. These accidents not only involve the expense of renewing the plates, but sometimes occasion interruptions and delays in works of a very pressing nature. These are some among the many advantages which may be expected to accrue from the introduction of iron electrotypes.

Apr. 17, 1873

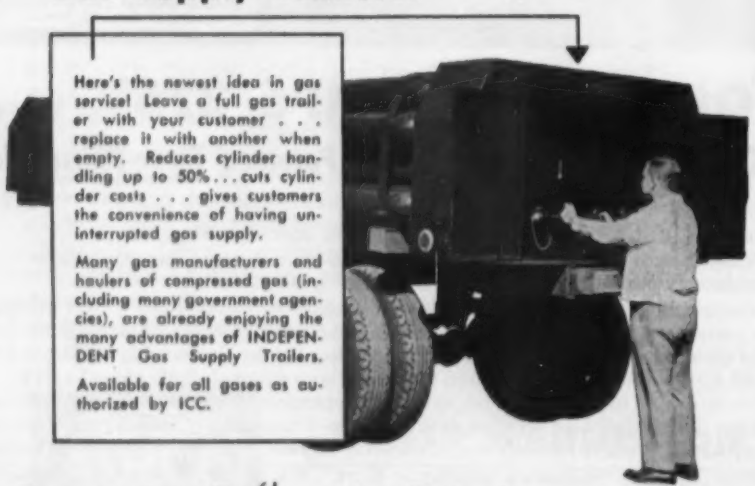
Shipping Problem

As illustrating the excessively low rates at which ocean freights are being carried, we quote the following story from an English contemporary: "A new and cheap way of conveying goods from Liverpool to London has been inaugurated by an enterprising firm of Transatlantic steamship owners. A Liverpool firm having 1000 tons of rough freight for London, finding that 10/ was the lowest rate quoted, made overtures to the managers of a Transatlantic line, who accepted the goods at 6/, provided they were not tied as to delivery. The shippers, being in no hurry, accepted these terms, and the route specified in the bills of lading was via New York. The goods would go out to New York as dead weight, and would there be transferred into a London-bound streamer."

Jan. 15, 1885

REDUCE CYLINDER HANDLING

Up to 50% with INDEPENDENT Gas Supply Trailers!



Here's the newest idea in gas service! Leave a full gas trailer with your customer . . . replace it with another when empty. Reduces cylinder handling up to 50%... cuts cylinder costs . . . gives customers the convenience of having uninterrupted gas supply.

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We Invite Your Inquiries

ACKNOWLEDGMENT

In addition to those mentioned in the text or in photo credits, the editors also want to thank the following for their help in preparing this section:

Prof. R. A. Wyant, Rensselaer Polytechnic Institute; Frank Masterson, The Industrial Fasteners Institute; Aluminum Co. of America; Armstrong Cork Co.; Chase Brass & Copper Co., Inc.; Clark Bros. Bolt Co.; Foote Mineral Co.; General Electric Co.; Heli-Coil Corp.; A. O. Smith Corp.; The Taylor-Winfield Corp.



If your firm uses MACHINED parts that look anything like these COLD-FORMED parts...

We'll show you how to cut your costs 30% to 70%

9 out of 10 companies using small machined parts like these are wasting thousands of dollars per year!

We know! We've *proved* in plant after plant all over the country that parts cold-formed the Milford way cost 30% to 70% *less* than when made by machining or other methods . . . whether the quantity runs to a few thousands, or millions!

We'll *prove* that you can save 30% to 70% on *your* cost of small parts *and our work won't cost you one red cent!* Just tell us, *"Yes, we use small machined parts that look like these."* We'll take it from there! Contact your nearest Milford plant or office today!

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Aurora, Ill. (Aurora 2-4278)
Hatboro, Pa. (Osborn 5-4560)

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Cleveland 15, Ohio, 1836 Euclid Ave., Cherry 1-7577
Detroit 24, Mich., 16950 Harper Ave., Tuxedo 4-2530
Fort Worth, Tex., 2208 Hudson St., Lockwood 3658
Indianapolis 2, Ind., 1916 N. Meridian St., Talbot 4549
Jenkintown, Pa., 615 Greenwood Ave., Ogontz 1708
Newark 2, N. J., 972 Broad St., Market 2-5877
New York 17, N. Y., 40 East 40th St., Murray Hill 5-6860
Norwalk, Cal., 10920 So. Gard Ave., Torrey 3-2606
Pittsburgh 20, Pa., 1007 McCartney St., Walnut 1-5171
Racine, Wis., 1516 Washington Ave., Racine 2-2345
San Francisco 27, Cal., 80 Stonestown, Overland 1-4425
St. Louis 17, Mo., 7743 Arthur Ave., Mission 5-4344
St. Paul 5, Minn., 2166 Grand Ave., Emerson 3396
Seattle 4, Wash., 1927 1st Ave. So., Mutual 2450
Seneca Falls, N. Y., P. O. Box 110, Seneca Falls 813
Stratford, Conn., 239 Housatonic Ave., Edison 7-9647
Westwood, Mass., 77 Greenhill Rd., Norwood 7-2878-J

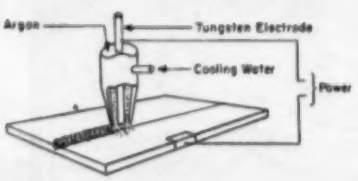
3 Modern Methods



BOOST...

- Production
- Profits
- Quality

Whatever your fabricating needs—in small shops or on production lines, on carbon steel, complex alloys or non-ferrous materials —LINDE has a high-speed, cost-saving electric welding process for every job. Here is the line-up of this top-notch team...



HELIARC Welding—*ideal for metals .020 in. and thicker*... Joins all commercial metals in easy operations—attains speeds over 100 inches per minute . . . Welding is done in all positions on all types of joints with portable manual, semi-automatic, and mechanized equipment.

There is no slag, spatter, or smoke—the operator can see and control the weld puddle at all times. Weld finishing is seldom necessary, and investment and maintenance costs are low.

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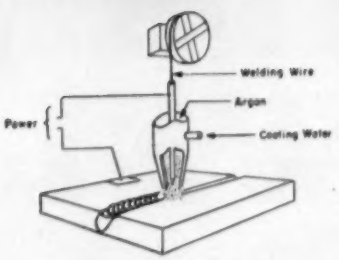
The terms "Heliarc," "Linde," and "Unionmelt" are registered trade-marks of Union Carbide and Carbon Corporation.

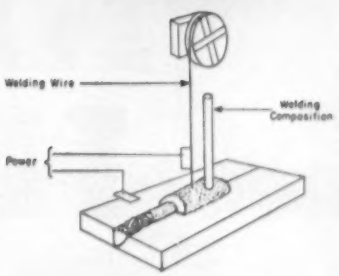
Linde Trade-Mark

For Joining Metals.....









Sigma Welding—*4 times faster wire deposition than by manual rod feed methods . . .* Full penetration up to ¼-in. in a single pass . . . Joins all commercial metals —and attains speeds of more than 100 inches per minute on many operations.

Uses any d.c., or c.p. (constant potential) power supply. With c.p., an operator has only to set the wire feed rate—current remains essentially constant throughout welding. Both manual and automatic mechanized sigma welding equipment is easy to operate and maintain.

UNIONMELT Welding—*joins metal of any thickness . . . Up to 3-in. thick in one pass.* Extreme depth of penetration and high rate of wire feed make this the fastest and usually the most economical of all welding processes. Deep penetration or wide shallow beads are easily attained by UNIONMELT welding.

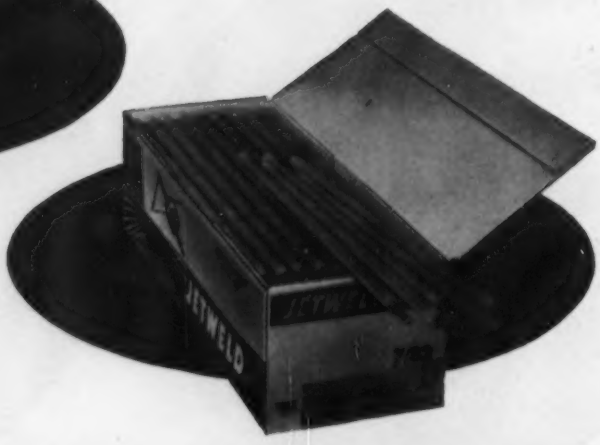
Both portable manual and mechanized setups are available, and can use any a.c., d.c., or c.p. (constant potential) power supply. With c.p., no control is necessary to maintain constant arc voltage throughout welding.

Start Saving Now — Call Your Local LINDE Representative Today . . .

Ask for Form 7942, "Modern Methods of Joining Metals."



Welding industry's greatest cost-cutting twins . . .



IDEALARC *and* JETWELD

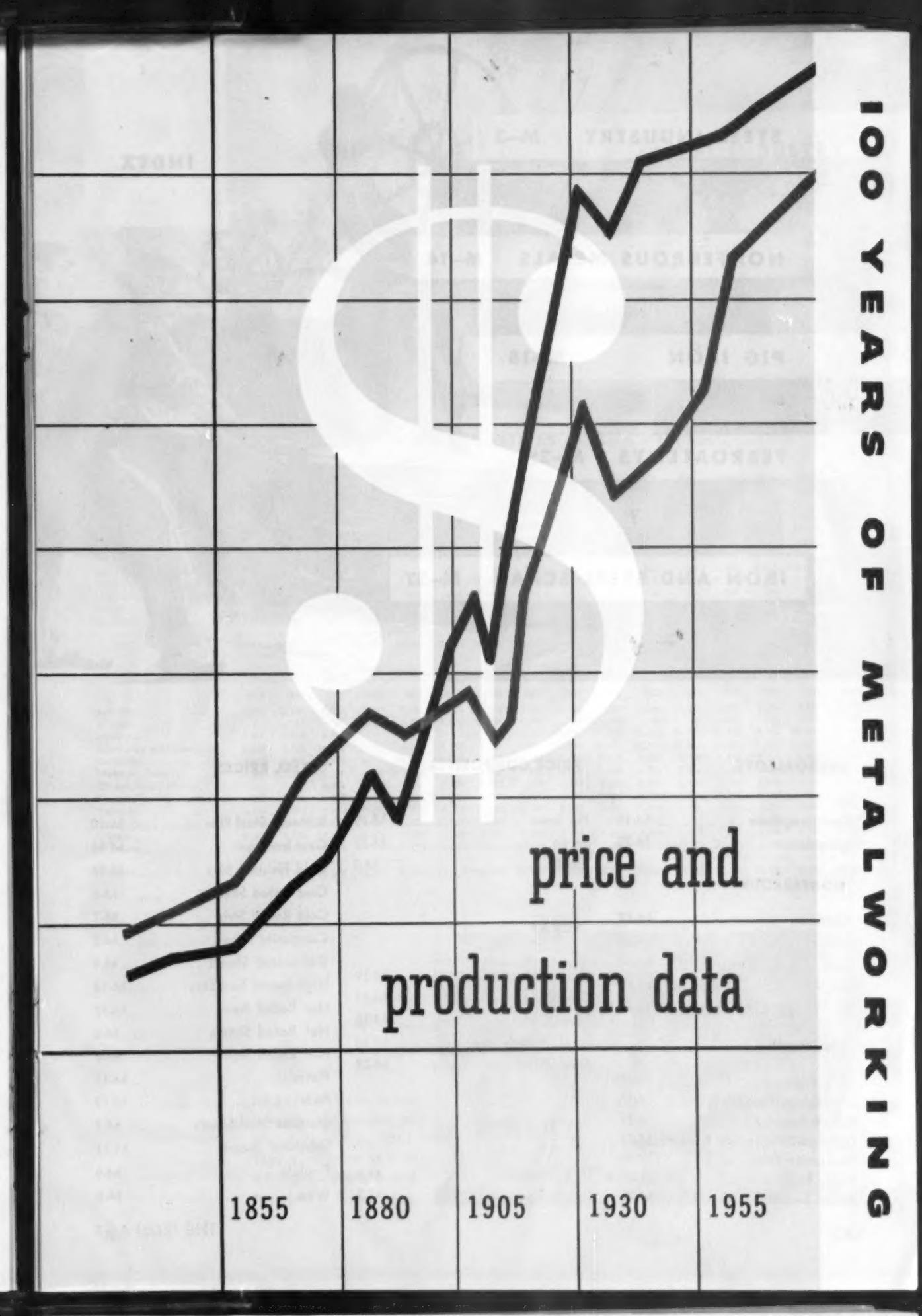
Never before has any combination of welder and electrode offered such a cost-saving potential in faster, easier welding. Here's why:

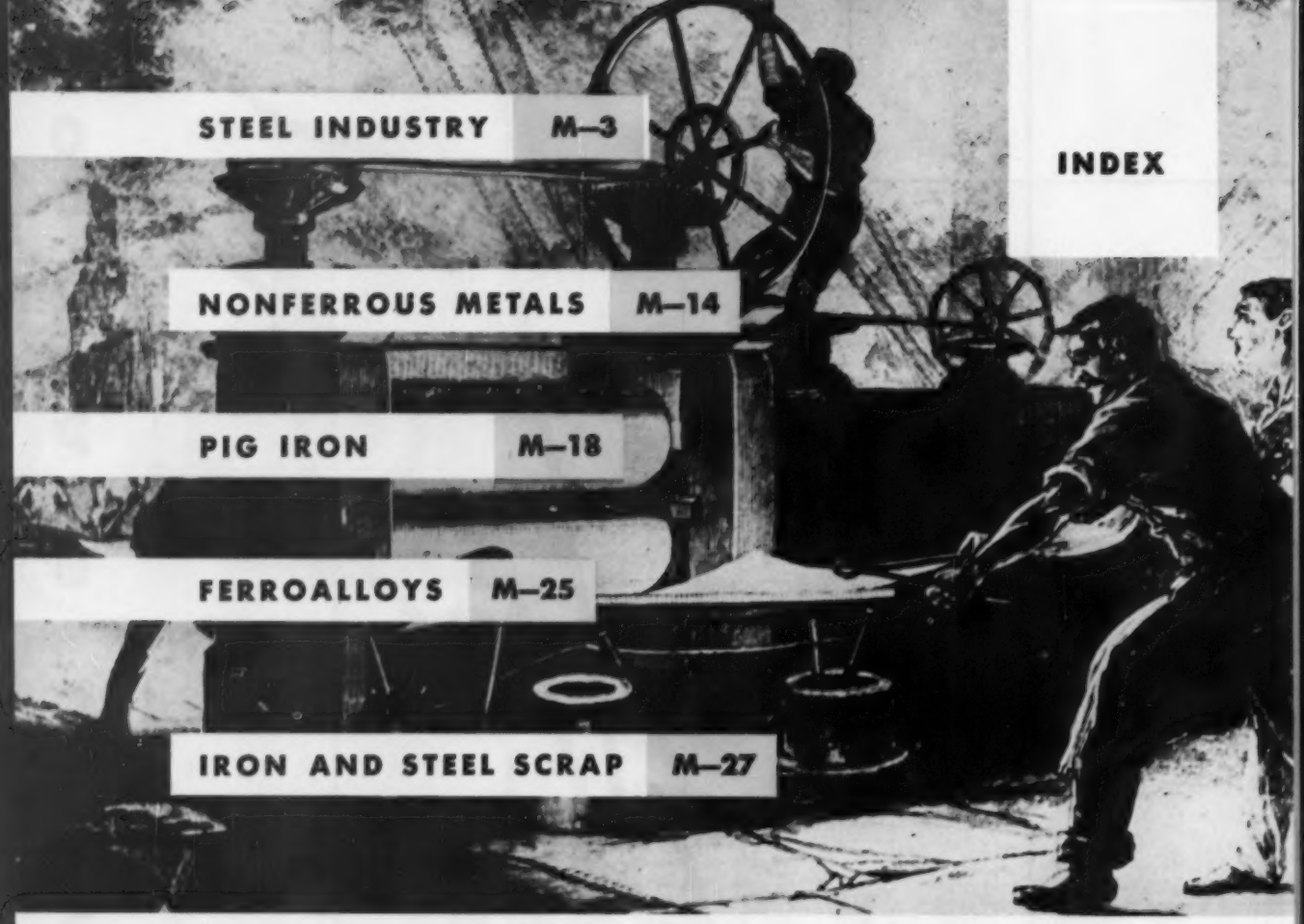
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AC AND DC WELDING CURRENT
with Dual Arc Control where you select "soft arc" or "forceful arc" on AC as well as DC
and in addition . . . hot starting on DC as well as AC

Jetweld for high-speed operation . . . first universally adopted iron-powder electrode for
extra-fast welding
high deposition
drag operation

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The World's Largest Manufacturer of Arc Welding Equipment


100 YEARS OF METALWORKING
price and
production data
1855
1880
1905
1930
1955



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PIG IRON M–18

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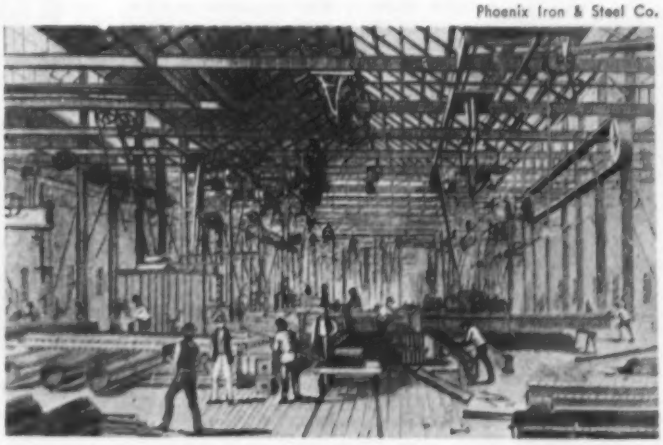
Steel production and distribution. Prices: Bars, galvanized sheets, pipe, plate, rails, sheet and strip, structurals, tinplate and tool steel.

STEEL DISTRIBUTION BY CONSUMING INDUSTRIES Thousands of Net Tons

	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Agriculture	1,806	988	1,264	2,020	1,967	2,970	3,061	1,709	1,350	605	111	1,233	1,976	2,238	2,335	1,110
Automotive	4,684	3,339	5,472	6,144	5,482	7,799	7,353	4,935	3,827	2,088	3,954	4,593	6,738	7,517	7,814	4,053
Construction and Maintenance	5,827	5,376	6,204	7,027	7,781	7,907	8,643	7,355	4,589	2,092	2,961	3,566	4,315	6,466	6,036	4,398
Containers	1,350	1,355	1,596	1,510	1,577	1,613	1,912	1,670	1,585	1,161	1,970	1,744	2,284	2,750	3,219	2,137
Machinery, Tools	1,168	1,127	1,514	1,273	1,170	1,805	2,029	1,342	791	441	782	825	1,091	1,663	1,804	831
Oil, Gas, Water, Mining	3,623	2,880	3,192	3,974	3,256	3,191	4,117	3,240	1,723	715	1,141	1,437	1,608	2,684	3,034	1,820
Pressing, Forming, Stamping	.....	.....	.....	.....	.....	584	700	643	412	187	580	606	1,208	1,583	1,494	868
Railroads	9,435	8,060	8,746	8,575	6,980	6,853	8,163	5,249	3,035	1,176	1,475	2,544	1,961	4,082	4,888	1,444
Shipbuilding	326	259	342	344	445	202	348	371	224	182	115	233	297	298	391	390
Exports	2,290	2,008	1,984	2,092	2,382	2,757	2,495	1,574	940	436	747	1,208	1,191	1,566	3,033	1,753
All Others	7,071	6,066	7,062	6,200	5,795	6,311	7,180	4,773	3,307	2,088	3,910	3,202	4,293	7,090	7,330	4,765
Total	37,270	31,458	37,396	39,758	38,825	42,180	45,996	33,052	21,463	11,704	17,746	21,241	28,840	37,886	41,178	23,569

	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954
Agriculture	1,421	1,630	1,683	1,188	1,462	1,950	2,426	1,645	2,422	2,743	2,644	3,094	3,291	2,764	2,947	2,417
Aircraft	.....	51	561	3,996	3,460	4,782	5,521	23	44	39	44	56	167	153	180	97
Automotive	5,906	7,985	9,047					5,894	10,292	11,330	11,880	15,748	14,488	12,232	16,506	12,959
Construction and Maintenance	6,100	6,936	10,221	10,715	6,640	6,248	8,353	7,867	10,039	10,157	10,020	12,363	14,184	11,749	14,225	12,906
Containers	2,978	3,068	4,612	4,071	4,301	3,878	4,333	4,370	5,586	5,844	5,026	6,409	7,242	6,218	6,789	6,427
Machinery, Tools	1,486	2,330	3,366	2,852	3,275	3,270	4,739	3,637	5,648	5,337	4,274	5,812	7,033	6,131	7,307	5,882
Oil, Gas, Water, Mining	1,842	1,900	2,929	1,586	1,903	2,464	2,670	1,950	3,833	5,080	5,455	6,619	6,735	5,973	7,211	6,097
Pressing, Forming, Stamping	1,842	2,296	3,677	2,783	2,639	1,935	3,000	3,100	3,770	5,256	3,124	4,601	4,617	3,640	4,994	3,628
Railroads	3,250	4,019	5,983	4,400	5,172	6,134	5,268	4,300	5,099	5,866	4,038	4,796	6,558	4,575	5,454	2,780
Shipbuilding	518	1,000	2,929	10,370	11,318	12,011	3,374	290	373	716	722	355	981	1,152	976	549
Exports	2,595	8,068	6,045	10,800	8,858	5,108	3,783	2,969	4,639	3,575	3,798	2,783	3,068	3,865	2,998	2,774
All Others	11,165	9,366	10,470	11,406	12,180	10,094	12,889	10,733	10,402	11,829	7,077	9,560	10,573	9,750	10,905	6,517
Total	39,067	48,659	62,323	63,747	61,400	63,048	80,946	48,868	67,880	65,975	58,102	72,194	78,927	68,902	80,152	63,153

Phoenix Iron & Steel Co.



FABRICATING hollow wrought iron columns at Phoenix Iron Co., 1862. They were made of 6 or 8 flanged sections, bolted together.

U. S. PRODUCTION OF INGOTS AND STEEL FOR CASTINGS

Net Tons, 1900-1954

Total Production—All Grades Including Carbon, Alloy and Stainless

Years	Openhearth	Bessemer	Crucible	Electric	Other**	Total
1954	80,327,494	2,548,104	*	5,436,054	.....	88,311,652
1953	100,473,823	3,656,705	*	7,280,191	.....	111,609,719
1952	82,946,439	3,823,677	*	6,797,923	.....	93,168,039
1951	93,166,818	4,830,946	*	7,142,384	.....	105,199,948
1950	86,262,509	4,334,566	*	6,039,000	.....	96,636,075
1949	70,248,603	3,946,656	*	3,782,717	.....	77,978,176
1948	79,340,157	4,243,172	*	5,067,141	.....	88,648,470
1947	76,873,793	4,232,543	*	3,787,735	.....	84,894,071
1946	60,711,963	3,327,727	*	2,563,024	.....	66,602,724
1945	71,930,602	4,305,318	24	3,466,704	.....	79,701,648
1944	80,363,953	5,039,923	25	4,237,699	.....	89,641,600
1943	70,621,004	5,025,492	146	4,589,070	.....	80,236,512
1942	76,501,957	5,553,424	2,010	3,974,549	.....	86,031,931
1941	74,388,619	5,578,071	2,313	2,889,256	.....	82,639,259
1940	61,573,063	3,709,573	1,024	1,700,006	.....	66,982,666
1939	48,409,800	3,386,916	931	1,029,067	.....	52,796,714
1938	29,060,016	2,106,340	7	865,627	.....	31,751,990
1937	51,824,979	3,963,918	1,046	947,002	.....	56,636,945
1936	48,780,463	3,873,472	914	865,150	.....	53,499,999
1935	34,401,286	3,175,235	719	806,471	.....	38,163,705
1934†	26,384,638	2,421,840	886	494,661	.....	29,181,924
1933	22,827,473	2,720,946	763	471,747	.....	26,020,229
1932	13,336,210	1,715,925	722	270,044	.....	15,322,901
1931	25,216,714	3,386,258	1,733	460,255	.....	29,056,961
1930	39,256,073	5,639,714	2,823	666,111	.....	45,563,421
1929	54,155,235	7,977,210	7,442	1,065,603	.....	63,205,490
1928	49,497,831	7,414,616	9,701	998,531	.....	57,729,481
1927	42,636,536	6,934,734	10,120	746,018	.....	50,327,407
1926	45,575,016	7,760,716	17,352	729,930	.....	54,080,014
1925	42,998,027	7,530,037	21,010	699,373	.....	50,849,747
1924	35,388,632	6,667,541	25,170	484,429	.....	42,483,772
1923	40,397,016	9,602,179	49,386	577,777	.....	50,336,940
1922	32,629,061	6,629,614	32,639	387,863	.....	39,679,277
1921	17,460,579	4,467,651	8,927	189,839	1,058	22,157,053
1920	36,092,522	9,949,057	80,937	882,411	3,959	47,188,886
1919	30,182,537	8,144,148	71,201	430,586	3,306	38,831,779
1918	36,994,518	10,601,304	129,925	572,728	368	48,797,823
1917	38,248,780	11,737,655	141,922	341,089	354	50,467,880
1916	35,185,278	12,386,124	145,286	169,189	676	47,906,822
1915	26,620,594	9,281,679	127,436	77,742	1,710	36,008,161
1914	19,233,648	6,967,348	100,653	29,880	4,057	26,334,584
1913	24,181,923	10,681,191	135,773	33,601	4,291	35,066,979
1912	23,274,410	11,867,249	136,099	20,506	3,195	35,601,458
1911	17,470,488	8,901,890	109,371	32,680	3,185	26,517,238
1910	18,488,060	10,642,308	139,979	56,388	3,677	29,226,300
1909	16,233,286	10,483,477	120,238	15,413	10,286	26,829,624
1908	6,777,136	6,850,766	71,267	.....	6,866	13,706,037
1907	12,935,704	13,067,656	148,982	.....	15,794	26,168,186
1906	12,296,063	13,748,930	142,815	.....	16,105	26,205,913
1905	10,047,941	12,284,340	114,801	.....	10,839	22,426,921
1904	6,617,148	8,902,237	93,390	.....	10,293	15,923,074
1903	6,529,500	9,623,966	114,726	.....	10,981	16,279,175
1902	6,370,286	10,234,967	126,366	.....	9,392	16,740,920
1901	5,218,666	9,788,866	110,335	.....	6,127	15,080,426
1900	3,808,811	7,486,942	112,629	.....	8,446	11,418,828

* Included with electric steel.

† The figures for 1934 and subsequent years include only that portion of the steel casting production which was produced in foundries operated by companies producing steel ingots.

** Cementation and other miscellaneous processes.

Years	Openhearth	Bessemer	Crucible	Cementation and Miscellaneous	Total
1899	3,300,994	8,496,716	113,388	5,571	11,916,649
1898	2,497,927	7,402,089	100,817	4,267	10,004,800
1897	1,901,712	6,132,353	79,384	3,373	8,015,792
1896	1,454,544	4,390,295	67,972	2,681	5,915,492
1895	1,273,644	5,499,223	75,788	961	6,848,614
1894	679,128	3,999,671	57,906	4,571	4,941,476
1893	826,437	3,801,568	71,247	3,143	4,802,395
1892	750,276	4,666,647	94,874	5,064	5,518,891
1891	649,323	3,637,107	71,296	5,922	4,372,748
1890	574,820	4,131,536	79,716	4,248	4,790,320
1889	419,488	3,291,829	84,969	5,734	3,792,020
1888	352,036	2,812,600	79,713	4,124	3,247,373
1887	360,717	3,288,357	84,429	6,266	3,739,769
1886	245,250	2,541,493	80,610	2,651	2,870,004
1885	149,381	1,761,761	84,511	1,697	1,917,350
1884	131,817	1,540,595	80,662	5,111	1,758,985
1883	133,679	1,684,626	80,455	5,589	1,874,359
1882	160,542	1,696,449	85,090	3,014	1,945,095
1881	148,946	1,539,157	89,762	3,047	1,778,912
1880	112,953	1,203,173	72,424	6,465	1,397,015
1879	58,290	929,972	58,780	5,464	1,047,506
1878	36,125	732,226	42,906	6,557	819,814
1877	25,031	560,587	40,430	11,924	637,972
1876	21,469	525,996	39,383	10,306	597,174
1875	9,050	375,517	39,402	12,606	436,575
1874	7,000	191,933	36,326	6,353	241,614
1873	3,500	170,663	34,786	13,713	222,652
1872	3,000	120,108	29,280	7,740	160,108
1871	2,000	45,000	35,500		82,000
1870	1,500	42,000	33,500		77,000
1869	1,000	12,000	22,000		35,000
1868	.....	8,500	21,500		30,000
1867	.....	3,000	19,000		22,000
1866	.....	.....	18,973		18,973
1865	.....	.....	15,262		15,262
1864	.....	.....	10,369		10,369
1863	.....	.....	9,044		9,044
1860	.....	.....	13,250		13,250
1810	.....	.....	1,027		1,027

Sources: THE IRON AGE and American Iron and Steel Institute

Bettmann Archive



ROLLING MILL and forge works of Glendon Co., Boston, from an 1854 engraving. Note multiple stand mill.



Bettmann Archive

FILE MAKING circa 1880. Heat treating in foreground. The men at right appear to be making hardness tests.

THE IRON AGE finished steel composite price is now a weighted average of the base prices of 10 major steel products which account for the majority of finished steel shipments. It is weighted by the percentage that each of these products is to total finished steel shipments during the base period. With the base constant, the only changes in the composite from 1929 through 1940 or from 1941 through 1949 occur when one or more steel products prices were changed.

In the composite shown here there are three base periods. From 1902 through 1928 it was an arithmetical average of carbon bars, beams, tank plates, plain wire, openhearth rails, black pipe and black sheets.

For the years 1929 through 1940 the base is finished steel shipments for 1929-1939 inclusive. For 1941 through 1950 the base is finished steel shipments for the 7 years 1937 to 1940 inclusive and 1946 to 1948 inclusive. Two base periods are used because of basic changes in the shipment pattern in the 20 years covered. In each case the products remain the same. They are hot-rolled bars, structural shapes, plates, rails, pipe, wire and hot- and cold-rolled sheets and strip. To eliminate variations due to nonferrous metals price fluctuations, no coated products are included.

Details of latest revisions which appear in current series may be found in The Iron Age, May 12, 1949, p. 189. This reference also gives a comparison of current series with former series.

THE IRON AGE FINISHED STEEL COMPOSITE PRICE

Cents Per Pound, 1902-1954

	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926
Jan.	2.026	1.921	1.740	1.713	1.747	1.887	1.923	1.82	1.741	1.615	1.424	1.771	1.451	1.383	2.06	3.304	3.849	3.371	3.168	3.057	2.089	2.489	2.783	2.569	2.447
Feb.	2.065	1.875	1.751	1.725	1.749	1.899	1.92	1.772	1.736	1.62	1.40	1.766	1.477	1.395	2.203	3.501	3.849	3.371	3.488	2.916	2.007	2.605	2.782	2.546	2.429
Mar.	2.075	1.868	1.769	1.783	1.746	1.905	1.92	1.599	1.727	1.623	1.394	1.706	1.473	1.413	2.447	3.739	3.849	3.282	3.743	2.784	2.014	2.721	2.746	2.537	2.433
Apr.	2.063	1.868	1.764	1.793	1.741	1.931	1.92	1.577	1.727	1.627	1.433	1.79	1.448	1.437	2.611	4.110	3.849	3.031	3.842	2.737	2.075	2.614	2.692	2.503	2.439
May	2.064	1.868	1.757	1.799	1.741	1.933	1.92	1.508	1.72	1.62	1.456	1.727	1.424	1.433	2.75	4.662	3.849	3.021	3.804	2.784	2.113	2.793	2.639	2.480	2.416
June	2.070	1.868	1.737	1.779	1.763	1.927	1.851	1.508	1.707	1.558	1.47	1.657	1.399	1.444	2.889	5.004	3.849	3.021	3.786	2.943	2.148	2.799	2.610	2.440	2.429
July	2.108	1.884	1.702	1.779	1.763	1.927	1.82	1.543	1.657	1.546	1.504	1.667	1.40	1.471	2.64	5.334	3.549	3.021	3.888	2.485	2.189	2.783	2.563	2.435	2.431
Aug.	2.136	1.879	1.674	1.783	1.763	1.927	1.82	1.581	1.636	1.539	1.583	1.634	1.446	1.511	2.662	5.249	3.549	3.021	3.967	2.341	2.292	2.775	2.516	2.413	2.431
Sept.	2.126	1.871	1.621	1.786	1.763	1.934	1.82	1.616	1.627	1.513	1.61	1.591	1.47	1.559	2.765	5.049	3.549	3.004	3.956	2.248	2.419	2.775	2.487	2.397	2.439
Oct.	2.047	1.867	1.620	1.72	1.78	1.934	1.82	1.664	1.613	1.441	1.659	1.559	1.446	1.634	2.886	3.470	3.55	3.052	3.81	2.218	2.461	2.775	2.464	2.406	2.449
Nov.	1.961	1.812	1.632	1.723	1.82	1.934	1.82	1.674	1.613	1.497	1.70	1.805	1.397	1.709	3.021	3.444	3.549	3.004	3.868	2.129	2.445	2.775	2.481	2.433	2.453
Dec.	1.903	1.781	1.691	1.727	1.87	1.934	1.82	1.727	1.611	1.399	1.725	1.463	1.366	1.941	3.278	3.441	3.461	3.11	3.114	2.107	2.439	2.775	2.540	2.468	2.463
Avg.	2.057	1.868	1.707	1.758	1.77	1.923	1.884	1.632	1.682	1.542	1.529	1.683	1.434	1.534	2.671	4.108	3.542	3.115	3.675	2.532	2.220	2.736	2.609	2.468	2.437

	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940*	1948*	1946	1947	1948	1949	1950	1951	1952	1953	1954
Jan.	2.432	2.316	2.276	2.229	1.991	1.852	1.830	1.958	2.065	2.078	2.323	2.584	2.364	2.305	2.412	2.464	2.877	3.193	3.720	3.837	4.131	4.131	4.376	4.634
Feb.	2.378	2.361	2.278	2.212	1.998	1.843	1.812	1.988	2.065	2.065	2.323	2.581	2.364	2.305	2.427	2.866	2.884	3.216	3.719	3.837	4.131	4.131	4.376	4.634
Mar.	2.367	2.362	2.276	2.208	1.992	1.852	1.809	1.988	2.065	2.065	2.632	2.576	2.364	2.305	2.432	2.719	2.884	3.241	3.715	3.837	4.131	4.131	4.376	4.634
Apr.	2.360	2.359	2.304	2.400	1.974	1.892	1.780	2.007	2.065	2.062	2.584	2.578	2.364	2.307	2.433	2.719	2.884	3.241	3.709	3.837	4.131	4.131	4.376	4.634
May	2.360	2.380	2.307	2.118	1.968	1.891	1.770	2.184	2.065	2.062	2.584	2.580	2.308	2.305	2.436	2.719	2.884	3.214	3.706	3.837	4.131	4.131	4.393	4.63_4
June	2.380	2.341	2.318	2.093	1.961	1.888	1.766	2.154	2.065	2.067	2.584	2.513	2.263	2.305	2.464	2.719	2.884	3.211	3.706	3.837	4.131	4.131	4.517	4.63_4
July	2.367	2.325	2.312	2.056	1.940	1.892	1.841	2.107	2.065	2.139	2.584	2.388	2.263	2.306	2.464	2.719	2.914	3.293	3.706	3.837	4.131	4.180	4.634	4.78_9
Aug.	2.367	2.348	2.294	2.031	1.943	1.888	1.851	2.065	2.065	2.139	2.584	2.399	2.263	2.306	2.464	2.719	3.193	3.720	3.706	3.837	4.131	4.376	4.634	4.80_1
Sept.	2.386	2.348	2.282	2.011	1.943	1.883	1.879	2.065	2.065	1.146	2.584	2.367	2.263	2.306	2.464	2.719	3.193	3.720	3.706	3.837	4.131	4.376	4.634	4.80_1
Oct.	2.319	2.363	2.270	2.001	1.942	1.873	1.955	2.065	2.070	2.172	2.584	2.320	2.263	2.306	2.464	2.719	3.193	3.720	3.706	3.837	4.131	4.376	4.634	4.79_8
Nov.	2.299	2.367	2.265	1.993	1.937	1.886	1.947	2.065	2.070	2.172	2.584	2.354	2.268	2.305	2.464	2.719	3.193	3.720	3.706	3.837	4.131	4.376	4.633	4.79_7
Dec.	2.310	2.388	2.278	1.975	1.902	1.881	1.982	2.065	2.070	2.283	2.584	2.354	2.306	2.305	2.464	2.747	3.193	3.720	3.756	4.131	4.131	4.376	4.633	4.79_1
Avg.	2.357	2.332	2.298	2.111	1.957	1.873	1.881	2.051	2.068	2.118	2.536	2.459	2.311	2.302	2.449	2.686	3.014	3.434	3.713	3.882	4.131	4.237	4.516	4.716

* 1941-1944 inclusive: 2.386.

HOT ROLLED SHEETS Cents Per Pound, at Pittsburgh

	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925
Jan.	2.67	2.00	3.67	2.75	2.29	2.30	2.40	2.60	2.52	2.50	2.40	2.20	1.90	2.31	1.87	1.60	2.60	4.50	5.00	4.70	4.48	4.35	3.00	3.35	3.00	2.70
Feb.	3.03	2.94	3.10	2.75	2.25	2.30	2.40	2.60	2.50	2.50	2.40	2.20	1.87	2.35	1.95	1.60	2.60	4.60	5.00	4.70	5.00	4.21	3.00	3.46	3.00	2.70
Mar.	3.10	3.22	3.10	2.75	2.27	2.34	2.30	2.60	2.50	2.25	2.40	2.20	1.80	2.35	1.95	1.60	2.71	4.94	5.00	4.61	5.00	3.66	3.00	3.71	2.93	2.69
Apr.	3.20	3.35	3.12	2.75	2.25	2.40	2.35	2.60	2.50	2.20	2.40	2.20	1.86	2.35	1.91	1.60	2.85	5.75	5.00	4.35	5.50	3.66	3.11	4.00	2.86	2.53
May	3.20	3.30	3.10	2.75	2.20	2.40	2.35	2.60	2.50	2.20	2.40	2.20	1.90	2.30	1.85	1.79	2.89	7.00	5.00	4.35	5.50	4.00	3.15	3.86	2.80	2.40
June	3.05	3.30	3.05	2.75	2.16	2.30	2.50	2.60	2.50	2.20	2.40	2.00	1.90	2.27	1.81	1.75	2.90	7.00	5.00	4.35	5.50	3.90	3.15	3.85	2.76	2.31
July	3.15	3.10	3.00	2.74	2.10	2.26	2.50	2.60	2.50	2.20	2.24	2.00	1.95	2.25	1.80	1.75	2.90	8.50	5.00	4.35	6.75	3.31	3.15	3.81	2.68	2.30
Aug.	2.96	3.41	3.06	2.70	2.10	2.26	2.50	2.60	2.50	2.20	2.21	1.96	2.02	2.21	1.80	1.85	2.90	8.50	5.00	4.35	7.50	2.90	3.23	3.75	2.63	2.30
Sept.	2.94	3.77	2.97	2.65	2.10	2.25	2.50	2.60	2.50	2.26	2.15	1.91	2.07	2.14	1.86	1.90	2.93	8.50	5.00	4.35	7.36	2.81	3.35	3.75	2.69	2.25
Oct.	2.90	3.23	2.79	2.62	2.10	2.25	2.50	2.60	2.50	2.30	2.20	1.86	2.21	2.04	1.94	2.03	3.23	....	5.05	4.35	6.60	3.00	3.47	3.75	2.70	2.26
Nov.	2.86	3.10	2.75	2.49	2.13	2.27	2.60	2.60	2.50	2.30	2.20	1.85	2.25	1.97	1.87	2.25	3.65	5.00	5.00	4.35	5.77	2.86	3.35	3.75	2.70	2.40
Dec.	2.96	3.10	2.75	2.32	2.22	2.30	2.60	2.60	2.50	2.40	2.19	1.84	2.25	1.89	1.82	2.50	4.31	5.00	4.65	4.35	4.35	3.00	3.35	3.75	2.70	2.50
Avg.	3.03	3.23	2.99	2.67	2.18	2.30	2.47	2.60	2.50	2.29	2.30	2.04	2.00	2.20	1.88	1.92	3.04	6.39	4.99	4.43	5.83	3.50	3.19	3.73	2.79	2.45

	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940†	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954
Jan.	2.50	2.25	2.10	2.10	2.10	1.90	1.75	1.62	1.75	1.85	1.85	2.15	2.40	2.15	2.10	2.10	2.20	2.50	2.50	2.80	3.20	3.35	3.60	3.60	3.775	3.925
Feb.	2.50	2.20	2.10	2.10	2.10	1.90	1.75	1.60	1.75	1.85	1.85	2.15	2.40	2.15	2.10	2.10	2.31	2.50	2.50	2.80	3.20	3.35	3.60	3.60	3.775	3.925
Mar.	2.50	2.20	2.10	2.10	2.10	1.90	1.71	1.55	1.75	1.85	1.85	2.40	2.40	2.15	2.10	2.15	2.43	2.50	2.50	2.80	3.20	3.35	3.60	3.60	3.775	3.925
Apr.	2.43	2.15	2.05	2.10	2.06	1.85	1.70	1.55	1.81	1.85	1.85	2.40	2.40	2.15	2.10	2.20	2.43	2.50	2.50	2.80	3.20	3.35	3.60	3.60	3.775	3.925
May	2.40	2.22	2.00	2.13	2.00	1.85	1.70	1.44	2.00	1.85	1.85	2.40	2.36	2.03	1.83	2.20	2.43	2.50	2.50	2.77	3.25	3.35	3.60	3.60	3.775	3.925
June	2.32	2.25	2.00	2.20	2.00	1.85	1.70	1.50	2.00	1.85	1.87	2.40	2.27	2.00	2.10	2.20	2.43	2.50	2.50	2.77	3.25	3.25	3.60	3.60	3.635	3.925
July	2.30	2.25	2.00	2.14	2.00	1.85	1.70	1.65	1.90	1.85	1.95	2.40	2.15	2.00	2.10	2.20	2.43	2.50	2.50	2.80	3.25	3.35	3.60	3.635	3.925	4.042
Aug.	2.30	2.25	2.00	2.10	1.93	1.85	1.70	1.65	1.95	1.85	1.95	2.40	2.15	2.00	2.10	2.20	2.43	2.50	2.50	2.80	3.25	3.25	3.35	3.60	3.775	3.925	4.05
Sept.	2.30	2.25	2.00	2.10	1.90	1.85	1.70	1.60	1.85	1.85	1.95	2.40	2.15	2.00	2.10	2.20	2.43	2.50	2.50	2.80	3.25	3.25	3.35	3.60	3.775	3.925	4.05
Oct.	2.30	2.14	2.00	2.10	1.90	1.85	1.70	1.75	1.85	1.85	1.95	2.40	2.03	2.00	2.10	2.20	2.43	2.50	2.50	2.80	3.25	3.25	3.35	3.60	3.775	3.925	4.05
Nov.	2.30	2.10	2.00	2.10	1.90	1.85	1.70	1.75	1.85	1.85	1.95	2.40	2.15	2.02	2.10	2.20	2.43	2.50	2.50	2.80	3.25	3.25	3.35	3.60	3.775	3.925	4.05
Dec.	2.30	2.10	2.00	2.10	1.90	1.90	1.70	1.75	1.85	1.85	2.15	2.40	2.15	2.10	2.10	2.20	2.40	2.50	2.50	2.80	3.25	3.25	3.60	3.60	3.775	3.925	4.05
Avg.	2.37	2.20	2.04	2.12	1.99	1.86	1.71	1.62	1.85	1.85	1.92	2.35	2.25	2.05	2.08	2.18	2.40	2.63	3.00	3.25	3.37	3.60	3.675	3.855	3.987

† 1941-1944 = 2.10¢.

* Base 1900 through Aug. 1926: 25 ga; Sept. 1926 to 0000: 24 ga; through 1954: 18 ga and heavier.

HOT ROLLED STRIP Cents Per Pound, at Pittsburgh

	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933
Jan.	....	4.50	3.30	3.45	3.30	2.00	2.75	3.00	2.25	2.30	2.34	2.01	1.80	1.90	1.65	1.41	1.45
Feb.	....	4.50	3.30	4.63	3.11	1.84	2.86	3.00	2.35	2.30	2.21	2.00	1.80	1.80	1.55	1.40	1.45
Mar.	....	4.50	3.30	5.00	2.93	1.81	3.10	2.93	2.40	2.30	2.30	2.10	1.80	1.79	1.55	1.40	1.45
Apr.	....	4.50	3.30	5.25	2.75	1.90	3.30	2.75	2.40	2.30	2.30	2.10	1.90	1.70	1.55	1.40	1.45
May	....	4.25	3.30	5.50	2.53	2.20	3.30	2.75	2.20	2.30	2.30	1.90	1.90	1.70	1.55	1.40	1.49
June	....	3.50	3.05	5.50	2.50	2.40	3.23	2.50	2.20	2.30	2.30	1.85	1.90	1.80	1.55	1.41	1.55
July	....	3.00	3.05	5.50	2.40	2.50	3.00	2.50	2.20	2.30	2.30	1.85	1.90	1.85	1.55	1.45	1.60
Aug.	....	3.00	3.31	5.50	2.23	2.60	3.00	2.35	2.20	2.30	2.30	1.85	1.90	1.85	1.55	1.45	1.64
Sept.	....	3.00	3.30	5.50	2.00	2.75	3.00	2.35	2.20	2.30	2.30	1.85	1.90	1.85	1.55	1.45	1.66
Oct.	....	3.00	3.30	5.25	2.00	2.90	3.00	2.35	2.23	2.30	2.19	1.85	1.90	1.80	1.54	1.45	1.75
Nov.	4.50	3.00	3.30	4.70	2.00	2.83	3.00	2.35	2.30	2.30	2.10	1.88	1.90	1.58	1.50	1.45	1.75
Dec.	4.50	3.00	3.30	3.05	2.00	2.75	2.88	2.35	2.30	2.30	2.03	1.80	1.90	1.55	1.49	1.45	1.75
Avg.	4.50	3.90	3.28	4.95	2.49	2.38	3.04	2.60	2.27	2.30	2.25	1.93	1.88	1.68	1.54	1.43	1.58

	1934	1935	1936	1937	1938	1939	1940†	1941*	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954
Jan.	1.75	1.85	1.85	2.15	2.40	2.15	2.10	2.10	2.50	2.60	3.20	3.25	3.50	3.90	3.725	3.925
Feb.	1.75	1.85	1.85	2.15	2.40	2.15	2.10	2.23	2.50	2.60	3.20	3.25	3.50	3.90	3.725	3.925
Mar.	1.75	1.85	1.85	2.35	2.40	2.15	2.10	2.35	2.50	2.60	3.20	3.25	3.50	3.90	3.725	3.925
Apr.	1.81	1.85	1.85	2.40	2.40	2.15	1.88	2.35	2.50	2.60	3.20	3.25	3.50	3.90	3.725	3.925
May	2.00	1.83	1.85	2.40	2.38	2.08	2.10	2.35	2.50	2.60	3.20	3.25	3.50	3.90	3.725	3.925
June	2.00	1.85	1.85	2.40	2.27	2.00	2.10	2.35	2.50	2.60	3.20	3.25	3.50	3.90	3.810	3.925
July	1.98	1.85	1.95	2.40	2.15	2.00	2.10	2.35	2.50	2.90	3.20	3.25	3.50	3.945	3.925	4.042
Aug.	1.85	1.85	1.95	2.40	2.15	2.00	2.10	2.35	2.60	3.20	3.25	3.25	3.50	3.725	3.925	4.05
Sept.	1.85	1.85	1.95	2.40	2.15	2.00	2.10	2.35	2.60	3.20	3.25	3.25	3.50	3.725	3.925	4.05
Oct.	1.85	1.85	1.95	2.40	2.03	2.00	2.10	2.35	2.60	3.20	3.25	3.25	3.50	3.725	3.925	4.05
Nov.	1.85	1.85	1.95	2.40	2.15	2.02	2.10	2.35	2.60	3.20	3.25	3.25	3.50	3.725	3.925	4.05
Dec.	1.85	1.85	2.11	2.40	2.15	2.10	2.10	2.47	2.60	3.20	3.25	3.50	3.50	3.725	3.925	4.05
Avg.	1.88	1.88	1.91	2.35	2.28	2.08	2.09	2.33	2.63	3.03	3.26	3.27	3.50	3.808	3.832	3.987

* Over 6 in.; add 0.10¢ for 6 in. and under from February through November 1948.

† 1941-1945 = 2.10¢.

COLD ROLLED STRIP Cents Per Pound, at Pittsburgh

	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933
Jan.	7.00	6.50	6.25	6.00	6.25	3.50	4.50	5.00	4.00	3.90	2.95	3.00	2.85	2.85	2.25	1.92	1.88
Feb.	7.25	6.50	6.25	7.00	6.06	3.50	4.60	4.75	4.00	3.90	2.80	3.00	2.85	2.85	2.25	1.90	1.80
Mar.	7.63	6.50	6.10	7.50	5.83	3.50	5.00	4.75	4.00	3.90	2.92	3.00	2.80	2.80	2.25	1.90	1.80
Apr.	7.31	6.50	5.85	7.75	5.54	3.61	5.25	4.75	4.00	3.79	3.00	3.00	2.75	2.88	2.23	2.00	1.80
May	7.60	6.50	5.65	8.50	4.98	3.71	5.25	4.50	3.94	3.75	3.00	3.00	2.75	2.80	2.15	2.00	1.88
June	8.63	6.50	5.65	8.50	4.88	4.00	5.19	4.50	3.53	3.72	3.19	3.00	2.75	2.45	2.15	2.00	2.00
July	9.00	6.50	5.65	8.50	4.25	4.00	5.00	4.30	3.63	3.60	3.25	2.92	2.75	2.45	2.15	2.00	2.19
Aug.	9.00	6.50	5.65	8.50	3.96	4.10	5.00	4.13	3.75	3.60	3.25	2.90	2.75	2.35	2.15	2.00	2.25
Sept.	9.00	6.50	5.65	8.50	3.78	4.25	5.00	4.00	3.75	3.50	3.25	2.72	2.75	2.35	2.15	1.92	2.29
Oct.	9.00	6.50	5.65	8.25	3.75	4.50	5.00	4.00	3.75	3.25	3.00	2.75	2.75	2.35	2.13	1.90	2.40
Nov.	8.75	6.50	5.65	8.00	3.75	4.50	4.98	4.00	3.90	3.25	3.00	2.85	2.75	2.33	2.05	2.00	2.40
Dec.	6.50	6.35	5.93	6.63	3.75	4.50	4.91	4.00	3.90	3.00	3.00	2.85	2.75	2.26	2.03	2.00	2.40
Avg.	7.89	6.49	5.81	7.76	4.73	3.97	4.98	4.39	3.85	3.60	3.05	2.92	2.77	2.48	2.16	1.97	2.09

	1934	1935	1936	1937	1938	1939	1940*	1946	1947	1948	1949	1950	1951	1952	1953	1954
Jan.	2.40	2.60	2.60	2.85	3.20	2.95	2.80	2.80	3.20	3.55	4.00	4.20	4.75	4.85	5.10	5.45
Feb.	2.40	2.60	2.60	2.85	3.20	2.95	2.80	2.93	3.20	3.55	4.00	4.21	4.75	4.85	5.10	5.45
Mar.	2.40	2.60	2.60	3.13	3.20	2.95	2.80	3.05	3.20	3.55	4.00	4.21	4.75	4.85	5.10	5.45
Apr.	2.60	2.60	2.60	3.20	3.20	2.95	2.80	3.05	3.20	3.55	4.00	4.21	4.75	4.85	5.10	5.45
May	2.60	2.60	2.60	3.20	3.18	2.86	2.80	3.05	3.20	3.53	4.00	4.21	4.75	4.85	5.10	5.45
June	2.60	2.60	2.60	3.20	3.07	2.80	2.80	3.05	3.20	3.53	4.00	4.21	4.75	4.85	5.25	5.45
July	2.64	2.60	2.60	3.20	2.95	2.80	2.80	3.05	3.27	3.55	4.00	4.21	4.75	4.74	5.45	5.73
Aug.	2.60	2.60	2.60	3.20	2.95	2.80	2.80	3.05	3.55	4.00	4.00	4.21	4.75	5.10	5.45	5.75
Sept.	2.60	2.60	2.60	3.20	2.95	2.80	2.80	3.05	3.55	4.00	4.00	4.21	4.75	5.10	5.45	5.75
Oct.	2.60	2.60	2.60	3.20	2.83	2.80	2.80	3.05	3.55	4.00	4.00	4.21	4.75	5.10	5.45	5.75
Nov.	2.60	2.60	2.60	3.20	2.95	2.80	2.80	3.05	3.55	4.00	4.00	4.21	4.75	5.10	5.45	5.75
Dec.	2.60	2.60	2.60	3.20	2.95	2.80	2.80	3.17	3.55	4.00	4.06	4.75	4.75	5.10	5.45	5.75
Avg.	2.58	2.60	2.62	3.14	3.05	2.86	2.79	3.03	3.35	3.76	4.01	4.25	4.75	4.85	5.29	5.60

* 1941-1945—2.80¢.

COLD ROLLED SHEETS Cents Per Pound, at Pittsburgh

	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940*	1946	1947	1948	1949	1950	1951	1952	1953	1954
Jan.	4.70	5.35	4.75	4.50	4.10	4.00	4.10	3.90	3.30	2.90	2.35	2.75	2.95	2.95	3.25	3.55	3.20	3.05	3.05	3.20	3.55	4.00	4.10	4.35	4.35	4.575	4.775
Feb.	4.78	5.35	4.68	4.43	4.15	4.00	4.10	3.90	3.90	2.80	2.25	2.75	2.95	2.95	3.25	3.50	3.20	3.05	3.10	3.20	3.55	4.00	4.10	4.35	4.35	4.575	4.775
Mar.	5.00	5.35	4.46	4.40	4.15	4.15	4.10	3.88	3.24	2.88	2.30	2.75	2.95	2.95	3.49	3.45	3.20	3.05	3.275	3.20	3.55	4.00	4.10	4.35	4.35	4.575	4.775
Apr.	5.00	5.25	4.40	4.33	4.15	4.04	4.10	3.80	3.10	2.90	2.30	2.85	2.95	2.95	3.55	3.45	3.20	2.93	3.275	3.20	3.55	4.00	4.10	4.35	4.35	4.575	4.775
May	5.35	5.10	4.40	4.29	4.15	4.00	4.10	3.75	3.03	2.89	2.34	3.15	2.95	2.95	3.55	3.43†	3.11	3.05	3.275	3.20	3.49	4.00	4.10	4.35	4.35	4.575	4.775
June	5.35	5.10	4.22	4.20	4.25	4.00	4.10	3.65	3.02	2.85	2.29	3.15	2.95	2.95	3.55	3.32	3.05	3.05	3.275	3.20	3.49	4.00	4.10	4.35	4.35	4.660	4.775
July	5.35	5.05	5.15	4.20	4.25	4.00	4.10	3.60	3.10	2.85	2.40	2.99	2.95	3.05	3.55	3.20	3.05	3.05	3.275	3.27	3.62	4.00	4.10	4.35	4.385	4.775	4.939
Aug.	5.35	4.75	4.25	4.20	4.25	4.00	4.08	3.60	3.10	2.81	2.47	2.95	2.95	3.05	3.55	3.20	3.05	3.05	3.275	3.55	4.00	4.00	4.10	4.35	4.575	4.775	4.95
Sept.	5.35	4.72	4.25	4.25	4.25	4.00	4.00	3.50	3.10	2.75	2.75	2.95	2.95	3.05	3.55	3.20	3.05	3.05	3.275	3.55	4.00	4.00	4.10	4.35	4.575	4.775	4.95
Oct.	5.35	4.60	4.29	4.25	4.15	4.00	4.00	3.45	3.40	2.65	2.75	2.95	2.95	3.05	3.55	3.00	3.05	3.05	3.275	3.55	4.00	4.00	4.10	4.35	4.575	4.775	4.95
Nov.	5.35	4.60	4.40	4.25	4.12	4.00	4.00	3.38	3.10	2.63	2.75	2.95	2.95	3.05	3.55	3.20	3.05	3.05	3.275	3.55	4.00	4.00	4.10	4.35	4.575	4.775	4.95
Dec.	5.25	4.75	4.50	4.25	4.00	4.08	3.98	3.30	3.02	2.65	2.75	2.95	2.95	3.25	3.55	3.20	3.05	3.05	3.215	3.55	4.00	4.04	4.35	4.35	4.575	4.775	4.95
Avg.	5.18	5.00	4.48	4.30	4.17	4.03	4.06	3.64	3.20	2.80	2.48	2.93	2.95	3.02	3.49	3.31	3.10	3.05	3.242	3.35	3.73	4.00	4.12	4.35	4.449	4.682	4.902

* 1941-1945—3.05¢.

Note: No. 22 gage prior to Sept. 1, 1926; No. 20 gage, Sept. 1, 1926-May 18, 1938.

† Cold rolled sheet base adopted May 18, 1938.

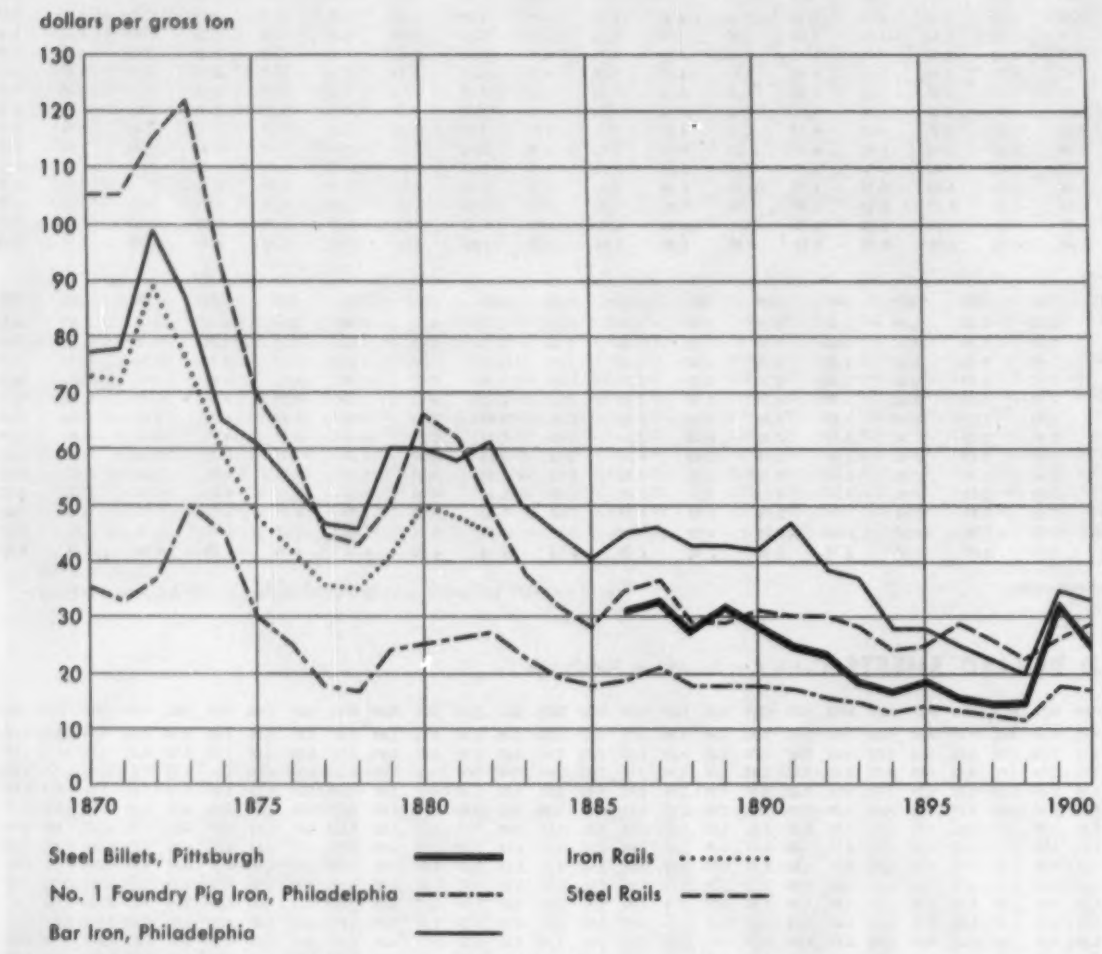
STAINLESS STEEL SHEETS Type 304, Cents Per Pound

	1937*	1946	1947	1948	1949	1950	1951	1952	1953	1954
Jan.	35.00	36.00	38.95	39.00	41.25	39.50	43.00	43.25	45.25	46.75
Feb.	35.00	36.00	39.00	39.00	41.25	39.50	43.00	43.25	45.25	46.75
Mar.	36.00	36.00	39.00	39.00	41.25	39.50	43.00	43.25	45.00	46.75
Apr.	36.00	36.21	39.00	39.00	40.61	39.50	43.00	43.25	46.50	46.75
May	36.00	36.95	39.00	39.00	39.50	39.50	43.00	43.25	46.50	45.63
June	36.00	36.95	39.00	39.00	39.50	39.50	43.00	43.25	47.46	43.75
July	36.00	36.95	39.00	39.00	39.50	40.52	43.25	43.67	46.75	43.75
Aug.	36.00	36.95	39.00	40.80	39.50	41.00	43.25	45.25	46.75	43.75
Sept.	36.00	36.95	39.00	40.37	39.50	41.00	43.25	45.25	46.75	43.75
Oct.	46.00	36.95	39.00	40.81	39.50	41.00	43.25	45.25	46.75	43.75
Nov.	36.00	36.95	39.00	41.25	39.50	41.00	43.25	45.25	46.75	43.75
Dec.	36.00	36.95	39.00	41.25	39.50	43.00	43.25	45.25	46.75	44.26
Avg.	36.83	36.15	38.99	39.79	40.05	40.38	43.125	44.13	47.43	45.62

* 1938-1945—36.00¢.

BARS, BILLETS, RAILS AND FOUNDRY IRON PRICES

1870-1900



BRIGHT WIRE Cents Per Pound, at Pittsburgh

	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938*	1945*	1946	1947	1948	1949	1950	1951	1952	1953	1954
Jan.	2.60	2.40	2.20	2.20	2.15	2.20	2.30	2.30	2.60	2.50	2.60	2.75	3 30	3 55	4 33	4.50	4.05	4 05	5 225	5 525
Feb.	2.60	2.40	2.20	2.20	2.10	2.20	2.30	2.30	2.60	2.50	2.60	2 90	3 30	3 55	4 33	4.50	4.05	4 05	5 225	5 525
Mar.	2.60	2.40	2.20	2.20	2.10	2.20	2.30	2.30	2.84	2 90	2 60	3 05	3 35	3 55	4 22	4.50	4.05	4 05	5.225	5.525
Apr.	2.60	2.38	2.20	2.20	2.10	2.23	2.30	2.40	2.90	2.90	2 60	3 05	3.30	3 55	4 15	4 50	4 05	4 05	5 225	5 525
May	2.60	2.30	2.20	2.20	2.10	2.30	2.30	2.40	2 90	2.90	2 63	3 05	3 33	3 63	4 15	4.50	4 05	4 05	5 225	5 525
June	2.60	2.30	2.20	2.20	2.10	2.30	2.30	2.40	2 90	2.84	2 75	3 05	3.30	3 60	4 15	4.50	4 05	4.83	5 352	5.525
July	2.60	2.30	2.20	2.20	2.10	2.30	2.30	2.40	2.90	2.60	2 75	3 05	3 38	3 77	4 15	4.50	4 05	4.925	5.525	5.735
Aug.	2.43	2.30	2.20	2.20	2.10	2.30	2.30	2.40	2.90	2.60	2.75	3 05	3 55	4 33	4 15	4.50	4.05	5.225	5.525	5.75
Sept.	2.40	2.30	2.20	2.20	2.10	2.30	2.30	2.40	2.90	2.60	2.75	3.05	3 55	4 33	4 15	4.50	4 05	5.225	5.525	5.75
Oct	2.40	2.30	2.20	2.20	2.10	2.30	2.30	2.50	2.90	2.60	2.75	3.05	3 55	4.33	4.15	4.50	4.05	5.225	5.525	5.75
Nov.	2.40	2.30	2.20	2.20	2.10	2.30	2.30	2.50	2.90	2.60	2.75	3.05	3.55	4.33	4.15	4.50	4.05	5.225	5.525	5.75
Dec.	2.40	2.22	2.20	2.20	2.20	2.30	2.30	2.60	2.90	2.60	2.75	3.10	3.55	4.33	4.29	4 55	4 05	5.225	5.525	5.75
Avg.	2.48	2.33	2.20	2.20	2.11	2.27	2.30	2.41	2.84	2.74	2.68	3 02	3 41	3 90	4.20	4 53	4.03	5 012	5 386	5.636

* 1938-1944—2.00%.
† Now called Manufacturers Bright Wire.

TINPLATE Dollars Per Base Box, at Pittsburgh

	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923
Jan.	$4.65	$4.00	$4.00	$3.60	$3.86	$3.55	$3.47	$3.90	$3.74	$3.70	$3.60	$3.60	$3.40	$3.00	$3.32	$3.10	$3.75	$7.00	$7.75	$7.35	$7.00	$7.00	$4.75	$4.75
Feb.	4.65	4.00	4.00	3.60	3.45	3.55	3.50	3.90	3.70	3.70	3.60	3.67	3.35	3.00	3.29	3.10	3.96	7.33	7.75	7.35	7.00	7.00	4.71	4.00
Mar.	4.65	4.00	4.00	3.60	3.45	3.56	3.50	3.90	3.70	3.53	3.60	3.70	3.30	3.00	3.30	3.25	4.19	8.00	7.75	7.25	7.00	7.00	4.60	5.23
Apr.	4.65	4.00	4.00	3.60	3.45	3.55	3.57	3.90	3.70	3.40	3.60	3.70	3.30	3.00	3.30	3.25	4.80	8.00	7.75	7.00	7.00	6.44	4.75	6.00
May	4.65	4.00	4.00	3.60	3.45	3.55	3.66	3.90	3.70	3.40	3.60	3.70	3.33	3.00	3.30	3.15	5.30	8.40	7.75	7.00	7.00	6.25	4.75	6.70
June	4.65	4.00	4.00	3.60	3.45	3.55	3.75	3.90	3.70	3.40	3.60	3.70	3.40	3.00	3.30	3.11	5.81	10.80	7.75	7.00	7.00	6.25	4.75	6.00
July	4.60	4.00	4.00	3.60	3.41	3.55	3.75	3.90	3.70	3.40	3.60	3.70	3.43	3.00	3.27	3.10	6.00	12.00	7.75	7.00	7.00	5.89	4.75	6.00
Aug.	4.00	4.00	4.00	3.60	3.30	3.55	3.75	3.90	3.70	3.40	3.60	3.70	3.50	3.55	3.41	3.10	6.05	11.40	7.75	7.00	9.00	5.25	4.75	5.90
Sept.	4.00	4.00	3.60	3.60	3.30	3.55	3.75	3.90	3.70	3.40	3.60	3.67	3.58	3.50	3.35	3.15	5.75	12.00	7.75	7.00	9.00	5.25	4.75	5.90
Oct.	4.00	4.00	3.60	3.60	3.30	3.34	3.75	3.90	3.70	3.50	3.60	3.52	3.60	3.50	3.24	3.15	5.81	.....	7.75	7.00	9.33	5.13	4.75	5.90
Nov.	4.00	4.00	3.60	3.65	3.39	3.34	3.90	3.90	3.70	3.56	3.60	3.40	3.60	3.40	3.15	3.20	5.97	7.75	7.75	7.00	7.50	4.75	4.75	5.90
Dec.	4.00	4.00	3.60	3.60	3.47	3.40	3.90	3.90	3.70	3.60	3.60	3.40	3.60	3.40	3.13	3.82	6.63	7.75	7.55	7.00	7.00	4.73	4.75	5.90
Avg.	4.37	4.00	3.87	3.74	3.42	3.50	3.00	3.90	3.70	3.50	3.60	3.62	3.45	3.55	3.20	3.10	5.39	9.11	7.73	7.08	7.53	5.90	4.73	5.42

	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938*	1947	1948	1949	1950	1951	1952	1953	1954
Jan.	$5.50	$5.50	$5.50	$5.50	$5.25	$5.35	$5.25	$5.00	$4.75	$4.25	$5.25	$5.25	$5.25	$4.85	$5.35	$5.75	$6.50	$7.75	$7.50	$8.10	$8.70	$8.95	$8.95
Feb.	5.50	5.50	5.50	5.50	5.25	5.35	5.25	5.00	4.75	4.25	5.25	5.25	5.25	4.85	5.35	5.75	6.50	7.75	7.50	8.70	8.70	8.95	8.95
Mar.	5.50	5.50	5.50	5.50	5.25	5.35	5.25	5.00	4.75	4.25	5.25	5.25	5.25	4.85	5.35	5.75	6.50	7.75	7.50	8.70	8.70	8.95	8.95
Apr.	5.50	5.50	5.50	5.50	5.25	5.35	5.25	5.00	4.75	4.25	5.25	5.25	5.25	5.35	5.35	5.75	6.50	7.75	7.50	8.70	8.70	8.95	8.95
May	5.50	5.50	5.50	5.50	5.25	5.35	5.25	5.00	4.75	4.25	5.25	5.25	5.25	5.35	5.35	5.75	6.70	7.75	7.50	8.70	8.70	8.95	8.95
June	5.50	5.50	5.50	5.50	5.25	5.35	5.25	5.00	4.75	4.25	5.25	5.25	5.25	5.35	5.35	5.75	6.70	7.75	7.50	8.70	8.70	8.95	8.95
July	5.50	5.50	5.50	5.50	5.25	5.35	5.25	5.00	4.75	4.25	5.25	5.25	5.25	5.35	5.35	5.75	6.72	7.75	7.50	8.70	8.75	8.95	8.95
Aug.	5.50	5.50	5.50	5.50	5.25	5.35	5.35	5.00	4.75	4.25	5.25	5.25	5.25	5.35	5.35	5.75	6.80	7.75	7.50	8.70	8.95	8.95	8.95
Sept.	5.50	5.50	5.50	5.50	5.25	5.35	5.25	5.00	4.75	4.85	5.25	5.25	5.25	5.35	5.35	5.75	6.80	7.75	7.50	8.70	8.95	8.95	8.95
Oct.	5.50	5.50	5.50	5.50	5.25	5.35	5.80	4.75	4.75	4.85	5.25	5.25	5.25	5.35	5.35	5.75	6.80	7.75	7.50	8.70	8.95	8.95	9.08
Nov.	5.50	5.50	5.50	5.50	5.25	5.35	5.60	4.75	4.55	4.65	5.25	5.25	5.25	5.35	5.15	5.75	6.80	7.75	7.50	8.70	8.95	8.95	9.08
Dec.	5.50	5.50	5.50	5.25	5.25	5.35	5.00	4.75	4.25	5.25	5.25	5.25	5.26	5.35	5.00	5.75	6.80	7.75	7.50	8.70	8.95	8.95	9.08
Avg.	5.50	5.50	5.50	5.48	5.25	5.35	5.19	4.94	4.69	4.43	5.25	5.25	5.25	5.22	5.31	5.75	6.77	7.75	7.50	8.67	8.81	8.95	8.98

* 1939-1946—$5.00.

* Quotations were "Per 100-lb base box" until Jan. 1, 1948 when price was quoted as "1.50-lb cokes, per 100-lb base box." In January, 1951 the base was changed to 1.25-lb cokes but above prices are adjusted, by use of extras, to reflect 1.50-lb cokes price since that time.

GALVANIZED SHEETS Cents Per Pound, at Pittsburgh

	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923
Jan.	3.93	4.36	4.64	3.70	3.36	3.35	3.45	3.67	3.59	3.55	3.60	3.20	2.90	3.40	2.87	2.79	4.75	8.25	6.25	6.05	8.33	5.70	4.00	4.35
Feb.	4.00	4.36	4.36	3.70	3.25	3.40	3.46	3.75	3.55	3.61	3.50	3.20	2.87	3.50	2.95	3.16	4.75	8.36	6.25	6.05	6.50	5.98	4.00	4.54
Mar.	4.32	4.84	4.36	3.78	3.23	3.45	3.43	3.75	3.55	3.26	3.50	3.20	2.80	3.60	2.95	3.40	4.75	8.69	6.25	5.96	7.00	5.05	4.00	4.93
Apr.	4.78	4.84	4.36	3.89	3.23	3.45	3.40	3.75	3.55	3.25	3.50	3.20	2.86	3.50	2.91	3.29	5.00	7.00	6.25	5.70	7.00	4.88	4.11	5.25
May	4.66	4.74	4.36	3.88	3.23	3.45	3.40	3.75	3.55	3.25	3.50	3.20	2.90	3.42	2.80	3.50	4.94	8.20	6.25	5.70	7.00	5.00	4.16	5.20
June	4.59	4.59	4.23	3.81	3.18	3.35	3.55	3.75	3.55	3.25	3.50	3.00	2.90	3.35	2.75	4.25	4.89	9.50	6.25	5.70	7.00	4.88	4.16	5.00
July	4.53	4.48	4.28	3.73	3.14	3.36	3.55	3.75	3.55	3.25	3.39	3.00	3.00	3.33	2.75	4.40	4.38	10.00	6.25	5.70	8.25	4.31	4.16	5.00
Aug.	4.43	4.74	4.16	3.66	3.14	3.32	3.55	3.75	3.55	3.25	3.30	2.99	3.12	3.24	2.85	3.71	4.21	10.00	6.25	5.70	9.00	3.90	4.23	5.00
Sept.	4.33	4.73	3.99	3.66	3.14	3.30	3.55	3.75	3.55	3.26	3.21	2.93	3.21	3.16	2.95	3.56	4.16	9.75	6.25	5.70	8.66	3.81	4.35	5.00
Oct.	4.26	4.55	3.87	3.73	3.14	3.30	3.56	3.75	3.55	3.55	3.20	2.85	3.36	3.00	2.95	3.50	4.41	....	6.25	5.70	8.16	4.00	4.50	5.00
Nov.	4.16	4.84	3.85	3.81	3.23	3.32	3.65	3.75	3.55	3.43	3.20	2.85	3.40	2.96	2.98	3.98	5.16	6.25	6.25	5.70	7.04	3.86	4.43	4.93
Dec.	4.36	4.84	3.78	3.40	3.31	3.35	3.65	3.75	3.55	3.50	3.19	2.89	3.40	2.90	2.78	4.75	6.00	6.25	6.15	5.70	5.70	4.00	4.35	4.89
Avg.	4.36	4.66	4.19	3.70	3.22	3.37	3.52	3.74	3.55	3.34	3.37	3.04	3.06	3.29	2.87	3.89	4.77	7.84	6.24	5.78	7.24	4.56	4.29	4.92

	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1946†	1946	1947	1948	1949	1950	1951	1952	1953	1954
Jan.	4.98	4.75	4.60	3.78	3.65	3.60	3.33	2.90	2.80	2.66	2.85	3.10	3.10	3.40	3.00	3.00	3.70	3.55	3.95	4.40	4.40	4.80	4.80	5.075	5.275
Feb.	5.00	4.75	4.53	3.71	3.65	3.60	3.30	2.90	2.75	2.50	2.85	3.10	3.10	3.40	3.00	3.50	3.88	3.55	3.95	4.40	4.40	4.80	4.80	5.075	5.275
Mar.	4.93	4.62	4.50	3.65	3.65	3.60	3.30	2.90	2.85	2.60	2.85	3.10	3.10	3.72	3.00	3.62	4.05	3.55	3.95	4.40	4.40	4.80	4.80	5.075	5.275
Apr.	4.88	4.45	4.50	3.63	3.65	3.60	3.30	2.84	2.85	2.63	2.95	3.10	3.10	3.50	3.00	3.65	4.05	3.55	3.95	4.40	4.40	4.80	4.80	5.075	5.275
May	4.80	4.29	4.43	3.72	3.59	3.60	3.23	2.90	2.85	2.70	3.25	3.10	3.10	3.50	3.00	3.66	4.05	3.55	3.91	4.40	4.40	4.80	4.80	5.075	5.275
June	4.76	4.21	4.28	3.85	3.50	3.60	3.19	2.74	2.85	2.70	3.25	3.10	3.10	3.50	3.00	3.70	4.05	3.55	3.91	4.40	4.40	4.80	4.80	5.160	5.275
July	4.56	4.19	4.24	3.85	3.46	3.60	3.13	2.90	2.95	2.85	3.13	3.10	3.20	3.50	3.00	3.70	4.05	3.63	4.03	4.40	4.40	4.80	4.856	5.275	5.439
Aug.	5.55	4.20	4.23	3.85	3.40	3.50	3.05	2.90	2.81	2.85	3.10	3.10	3.20	3.50	3.00	3.70	4.05	3.95	4.40	4.40	4.40	4.80	5.075	5.275	5.45
Sept.	4.60	4.20	3.83	3.85	3.40	3.50	3.00	2.90	2.75	2.85	3.10	3.10	3.20	3.50	3.00	3.70	4.05	3.95	4.40	4.40	4.40	4.80	5.075	5.275	5.45
Oct.	4.60	4.23	3.85	3.78	3.50	3.50	2.98	2.90	2.85	2.85	3.10	3.10	3.20	3.50	3.45	3.70	4.05	3.95	4.40	4.40	4.40	4.80	5.075	5.275	5.45
Nov.	4.60	4.50	3.85	3.66	3.50	3.48	2.95	2.90	2.85	2.85	3.10	3.10	3.20	3.50	3.50	3.70	4.05	3.95	4.40	4.40	4.40	4.80	5.075	5.275	5.45
Dec.	4.72	4.60	3.95	3.63	3.56	3.40	2.92	2.88	2.85	2.85	3.10	3.10	3.40	3.50	3.50	3.70	*3.63	3.95	4.40	4.40	4.80	4.80	5.075	5.275	5.45
Avg.	4.83	4.42	4.22	3.75	3.54	3.55	3.14	2.87	2.83	2.74	3.06	3.10	3.17	3.73	3.64	3.68	3.99	3.72	4.13	4.40	4.43	4.80	4.919	5.182	5.362

* Base: 28 gage, 1900 through August 1926; 24 gage, September 1926 through November 1946; 10 gage, December 1946 through 1954.

† 1939-1944 = 3.50¢.

BUTTWELD STEEL PIPE Per Net Ton, at Pittsburgh

	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930
Jan.	$36.10	$35.20	$34.20	$41.20	$64.84	$80.92	$63.36	$80.64	$77.30	$51.87	$61.13	$70.30	$70.30	$70.30	$70.30	$68.60	$70.30	$70.30
Feb.	36.10	36.00	35.42	43.63	68.95	80.92	63.36	83.36	76.88	51.87	66.50	70.30	70.30	70.30	70.30	68.60	70.30	70.30
Mar.	36.10	36.12	36.10	47.51	72.07	80.92	61.06	83.36	76.88	51.87	66.50	70.30	70.30	70.30	70.30	68.60	70.30	70.30
Apr.	36.60	35.84	36.10	51.26	81.51	80.92	76.88	83.36	71.63	51.87	66.02	70.30	70.30	70.30	70.30	69.86	70.30	66.50
May	37.20	35.20	36.00	53.72	92.62	80.92	76.88	83.36	67.62	51.87	70.30	70.30	70.30	70.30	70.30	70.30	70.30	66.50
June	36.60	35.20	36.00	53.72	96.21	80.92	76.88	83.36	67.62	51.87	70.30	70.30	70.30	70.30	70.30	70.30	70.30	66.50
July	36.00	35.20	36.00	53.72	105.09	80.92	76.88	83.36	64.63	51.87	70.30	70.30	70.30	70.30	70.30	70.30	70.30	66.50
Aug.	36.83	35.20	36.00	53.72	105.09	80.92	76.88	83.36	63.91	54.74	70.30	70.30	70.30	70.30	70.30	70.30	70.30	66.50
Sept.	36.10	35.20	36.00	55.21	105.09	80.92	76.88	83.36	60.21	57.43	70.30	70.30	70.30	70.30	70.30	70.30	70.30	66.50
Oct.	36.95	35.20	36.00	60.58	105.09	80.92	76.88	83.36	60.58	58.74	70.30	70.30	70.30	70.30	68.54	70.30	70.30	66.50
Nov.	35.20	34.23	36.90	66.57	91.70	80.92	76.88	83.36	60.58	61.13	70.30	70.30	70.30	70.30	68.79	70.30	70.30	66.50
Dec.	35.20	34.20	36.90	61.01	80.92	80.92	76.88	83.36	63.96	61.13	70.30	70.30	70.30	70.30	68.79	70.30	70.30	66.50
Avg.	36.42	35.32	37.47	52.25	81.73	80.92	78.31	83.13	66.14	54.69	68.71	70.30	70.30	70.30	69.57	69.84	70.30	67.45

	1931	1932	1933	1934	1935	1936	1937	1938†	1946	1947	1948	1949	1950	1951	1952	1953	1954
Jan.	$66.90	$64.84	$65.00	$61.75	$66.40	$66.40	$61.00	$71.00	$63.00	$79.00	$86.00	$103.00	$106.00	$117.00	$117.00	$124.00	$136.50
Feb.	66.90	64.84	65.00	61.75	66.40	64.98	61.00	71.00	66.00	79.00	91.50	103.00	106.00	117.00	117.00	124.00	136.50
Mar.	66.90	64.84	65.00	61.75	66.40	61.00	66.00	71.00	69.00	79.00	95.00	103.00	106.00	117.00	117.00	124.00	136.50
Apr.	66.90	64.84	66.00	63.41	66.40	61.00	71.00	71.00	69.00	79.00	95.00	103.00	106.00	117.00	117.00	124.00	136.50
May	63.80	64.84	66.00	66.40	66.40	61.00	71.00	71.00	69.00	79.00	94.60	103.00	106.00	117.00	117.00	125.88	136.50
June	64.84	64.84	66.00	66.40	66.40	61.00	71.00	71.00	69.00	79.00	93.00	103.00	106.00	117.00	117.00	132.75	136.50
July	64.84	64.84	61.75	66.40	66.40	61.00	71.00	63.00	69.00	79.00	95.00	103.00	106.00	117.00	116.75	136.50	141.16
Aug.	64.84	64.84	61.75	66.40	66.40	61.00	71.00	63.00	69.00	86.00	103.00	103.00	106.00	117.00	124.00	136.50	141.50
Sept.	64.84	65.00	61.75	66.40	66.40	61.00	71.00	63.00	69.00	86.00	103.00	103.00	106.00	117.00	124.00	136.50	141.50
Oct.	64.84	65.00	61.75	66.40	66.40	61.00	71.00	63.00	69.00	86.00	103.00	103.00	106.00	117.00	124.00	136.50	141.50
Nov.	64.84	65.00	61.75	66.40	66.40	61.00	71.00	63.00	69.00	86.00	103.00	103.00	106.00	117.00	124.00	136.50	141.50
Dec.	64.84	65.00	61.75	66.40	66.40	61.00	71.00	63.00	71.00	86.00	103.00	106.00	117.00	117.00	124.00	136.50	141.50
Avg.	65.29	64.89	61.63	66.32	66.40	62.01	69.17	67.00	69.42	82.75	97.21	103.17	106.75	117.00	120.06	131.14	138.97

† 1939-1945—$63.00.

* Computed from list discounts, for carload lots; 1 to 3 in.; ¼ to 3 in. prior to April 13, 1931. Standard T. & C.

CAST IRON PIPE Per Net Ton, at New York

	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924
Jan.	$27.50	$21.75	$24.50	$29.25	$24.50	$28.00	$29.75	$34.25	$27.00	$24.50	$25.50	$22.00	$22.00	$25.00	$22.00	$20.00	$29.00	$41.50	$55.35	$65.70	$66.30	$63.30	$47.30	$54.90	$61.60
Feb.	26.75	22.25	25.00	29.25	24.25	26.50	29.50	34.25	26.75	24.25	25.50	21.50	22.00	24.75	22.00	20.00	29.33	41.50	55.35	62.70	70.30	63.30	47.30	56.50	61.60
Mar.	26.75	21.50	25.25	30.75	24.25	26.75	30.50	34.00	26.25	25.25	25.50	21.00	22.00	23.87	22.00	20.00	29.75	43.10	55.35	62.70	71.30	63.30	47.60	57.75	61.60
Apr.	26.50	22.00	25.00	31.00	24.25	27.00	29.75	33.50	26.25	25.00	25.50	21.00	21.25	23.50	22.00	21.60	30.50	50.66	55.35	67.70	73.90	63.30	48.80	58.50	61.60
May	26.00	22.25	27.75	30.75	24.00	27.25	31.00	34.25	26.25	25.25	25.50	21.00	21.00	23.00	20.88	22.00	30.50	50.50	56.60	54.45	76.30	62.05	49.60	58.50	61.60
June	24.50	23.00	28.00	30.75	23.50	27.25	32.50	33.50	25.75	26.00	25.25	21.00	21.00	23.00	20.50	22.25	30.50	60.75	61.44	52.03	76.30	54.30	50.00	61.35	61.60
July	24.75	23.75	28.50	30.75	23.50	27.25	30.25	34.00	25.75	26.25	24.00	21.00	22.10	23.00	20.50	22.50	30.50	60.50	61.75	50.46	76.30	52.30	53.50	62.30	60.60
Aug.	23.50	23.75	29.50	29.50	23.50	27.75	30.50	32.50	25.25	26.00	23.50	21.00	22.00	23.00	20.50	23.25	30.50	66.50	61.75	52.33	76.53	46.05	54.10	62.62	60.60
Sept.	22.25	23.50	29.50	29.00	23.00	27.25	31.00	33.00	25.75	25.75	23.50	21.00	23.12	23.00	20.40	24.37	30.83	65.50	61.75	54.30	77.22	46.30	54.50	63.00	60.60
Oct.	21.75	24.00	29.50	29.00	23.25	28.25	33.00	33.50	25.75	25.50	23.00	21.00	24.50	23.00	20.00	25.25	31.50	61.00	67.70	56.30	77.22	47.30	54.50	63.00	60.35
Nov.	21.75	24.50	30.75	24.50	25.00	29.00	33.25	28.50	25.00	25.87	22.12	21.40	24.12	23.00	20.00	26.50	35.50	56.50	67.70	58.30	77.22	47.30	54.50	63.00*	58.50
Dec.	21.75	23.75	29.25	24.25	27.00	29.25	35.50	28.00	25.50	25.75	22.00	22.00	24.62	22.33	20.00	27.60	41.00	56.50	67.70	61.30	66.57	47.30	54.75	63.00*	58.20
Avg.	24.46	23.00	27.87	28.81	24.17	27.79	31.38	32.77	25.94	25.44	24.24	21.24	22.46	23.37	20.90	22.94	31.62	55.31	60.65	57.27	73.98	54.68	51.44	60.57	59.43

* Concession of $2 to $3 per ton from this price to consumers willing to accept winter delivery.

	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939*	1946*	1947	1948	1949	1950	1951	1952	1953	1954
Jan.	$54.60	$50.60	$48.60	$37.25	$39.60	$36.10	$37.90	$30.20	$35.30	$43.00	$45.00	$45.20	$48.00	$53.00	$48.00	$87.20	$73.60	$89.18	$105.95	$94.95	$105.00	$109.00	$114.00	$115.00
Feb.	54.60	50.60	48.60	37.25	39.35	38.60	37.90	29.70	35.30	43.00	45.00	45.20	48.00	53.00	49.00	87.20	73.75	89.18	105.95	92.36	109.00	109.00	114.00	115.50
Mar.	53.00	50.60	47.20	37.25	38.60	38.75	37.50	28.40	35.30	43.00	45.00	45.20	51.00	53.00	49.00	86.20	78.90	89.18	105.95	91.50	109.00	109.00	114.00	115.50
Apr.	52.60	50.60	47.35	36.25	37.40	38.50	35.40	26.20	35.30	43.00	45.00	45.20	53.00	53.00	49.00	82.20	79.80	89.18	103.90	91.50	109.00	109.00	114.00	115.50
May	50.85	50.60	45.80	37.60	36.85	39.90	34.15	28.20	35.30	43.00	45.00	45.20	53.00	53.00	49.00	82.20	79.80	92.34	94.95	91.50	109.00	109.00	114.00	115.50
June	50.00	50.60	44.42	37.60	36.10	39.90	33.70	28.20	35.30	44.00	45.15	45.20	53.00	52.20	49.00	82.20	79.80	95.50	94.95	91.50	109.00	109.00	114.00	115.50
July	50.00	50.60	42.75	37.60	33.20	39.30	32.90	28.73	36.30	45.00	45.20	45.90	53.00	49.00	49.00	89.80	80.50	95.50	94.95	91.50	109.00	109.00	115.50	115.50
Aug.	50.00	50.60	39.85	38.60	33.60	38.90	32.90	31.10	38.30	45.00	45.20	45.90	53.00	49.00	49.00	89.80	83.20	103.88	94.95	91.50	109.00	109.00	115.50	115.50
Sept.	50.00	49.85	37.25	35.60	33.60	38.90	32.90	31.30	38.30	45.00	45.20	45.90	53.00	49.00	49.00	89.80	83.30	105.95	94.95	91.50	109.00	111.50	115.50	115.50
Oct.	50.60	49.60	35.80	35.60	34.60	38.90	32.90	33.30	38.00	45.00	45.20	45.90	53.00	49.00	52.20	89.80	83.96	105.95	94.95	95.00	109.00	114.00	115.50	115.50
Nov.	50.60	49.60	36.25	37.32	34.60	38.85	32.90	33.33	43.00	45.00	45.20	45.90	53.00	49.00	52.20	89.80	84.18	105.95	94.95	96.00	109.00	114.00	115.50	115.50
Dec.	50.60	49.10	37.00	39.40	34.60	37.90	32.50	34.30	43.00	45.00	45.20	47.90	53.00	49.00	52.20	73.60	84.18	105.95	94.95	96.00	109.00	114.00	115.50	115.50
Avg.	51.85	50.25	42.91	37.11	36.04	38.70	34.50	30.41	37.01	44.00	45.11	45.71	52.00	50.93	49.80	85.23	80.25	97.31	98.45	92.98	108.67	110.46	114.75	115.50

* 1940-1945—$52.20.

STEEL PLATES Cents Per Pound, at Pittsburgh

	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924
Jan.	2.22	1.40	1.60	1.75	1.60	1.50	1.60	1.70	1.70	1.60	1.56	1.40	1.16	1.75	1.20	1.10	2.25	4.45	3.25	3.00	2.72	2.65	1.46	2.06	2.50
Feb.	2.17	1.40	1.60	1.60	1.60	1.50	1.60	1.70	1.70	1.52	1.55	1.40	1.11	1.71	1.20	1.10	2.56	4.60	3.25	3.00	3.50	2.33	1.39	2.23	2.45
Mar.	2.03	1.47	1.60	1.60	1.60	1.60	1.60	1.70	1.70	1.30	1.55	1.40	1.12	1.70	1.15	1.10	3.10	5.25	3.25	2.91	3.63	2.04	1.39	2.39	2.39
Apr.	1.87	1.57	1.60	1.60	1.60	1.60	1.60	1.70	1.70	1.27	1.55	1.40	1.21	1.68	1.15	1.15	3.86	5.88	3.25	2.65	3.75	2.10	1.48	2.50	2.28
May	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.70	1.70	1.29	1.51	1.39	1.25	1.60	1.12	1.15	3.75	6.00	3.25	2.65	3.75	2.20	1.56	2.50	2.20
June	1.39	1.60	1.60	1.60	1.60	1.60	1.60	1.70	1.62	1.25	1.46	1.35	1.25	1.45	1.10	1.16	3.63	6.00	3.25	2.65	3.55	1.95	1.63	2.50	2.18
July	1.16	1.60	1.75	1.60	1.60	1.60	1.60	1.70	1.60	1.33	1.41	1.35	1.30	1.45	1.10	1.22	3.44	6.00	3.25	2.65	3.38	1.85	1.70	2.50	2.00
Aug.	1.09	1.60	1.75	1.60	1.60	1.60	1.60	1.70	1.60	1.40	1.40	1.34	1.35	1.44	1.13	1.26	3.70	6.00	3.25	2.65	3.25	1.75	1.88	2.50	1.96
Sept.	1.11	1.60	1.75	1.60	1.44	1.60	1.60	1.70	1.60	1.46	1.40	1.29	1.47	1.40	1.20	1.34	4.00	6.00	3.25	2.53	3.25	1.84	2.13	2.50	1.82
Oct.	1.07	1.60	1.84	1.60	1.40	1.60	1.60	1.70	1.60	1.50	1.40	1.17	1.53	1.36	1.14	1.44	4.00	3.25	3.25	2.61	3.09	1.90	2.00	2.50	1.80
Nov.	1.31	1.60	1.82	1.60	1.40	1.60	1.62	1.70	1.60	1.54	1.40	1.13	1.50	1.26	1.06	1.65	4.15	3.25	3.25	2.65	2.81	1.84	1.99	2.50	1.83
Dec.	1.39	1.60	1.82	1.60	1.45	1.60	1.70	1.70	1.60	1.55	1.40	1.15	1.60	1.20	1.05	2.04	4.25	3.25	3.13	2.65	2.65	1.90	1.95	2.50	1.92
Avg.	1.54	1.55	1.70	1.61	1.54	1.58	1.61	1.70	1.64	1.42	1.47	1.31	1.33	1.50	1.14	1.31	3.53	5.08	3.24	2.72	3.26	1.93	1.72	2.43	2.12

	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1939*	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954
Jan.	2.00	1.86	1.90	1.81	1.90	1.83	1.84	1.50	1.60	1.70	1.80	1.80	2.05	2.25	2.10	2.25	2.85	2.95	3.50	3.50	3.70	3.70	3.90	4.10
Feb.	2.00	1.80	1.86	1.85	1.90	1.80	1.65	1.50	1.60	1.70	1.80	1.80	2.06	2.25	2.10	2.38	2.85	2.95	3.50	3.50	3.70	3.70	3.90	4.10
Mar.	2.00	1.86	1.85	1.85	1.90	1.80	1.65	1.52	1.60	1.70	1.80	1.80	2.21	2.25	2.20	2.50	2.85	2.95	3.50	3.50	3.70	3.70	3.90	4.10
Apr.	2.00	1.90	1.85	1.85	1.95	1.80	1.65	1.50	1.55	1.74	1.80	1.80	2.25	2.25	2.20	2.50	2.85	2.95	3.50	3.50	3.70	3.70	3.90	4.10
May	2.00	1.86	1.84	1.85	1.95	1.73	1.65	1.60	1.50	1.85	1.80	1.80	2.25	2.25	2.21	2.50	2.85	2.93	3.40	3.50	3.70	3.70	3.90	4.10
June	1.92	1.88	1.80	1.85	1.95	1.80	1.65	1.60	1.53	1.85	1.80	1.80	2.25	2.22	2.25	2.50	2.71	2.93	3.40	3.50	3.70	3.70	3.90	4.10
July	1.90	1.90	1.80	1.85	1.95	1.65	1.53	1.60	1.60	1.81	1.80	1.90	2.25	2.10	2.25	2.50	2.95	3.07	3.40	3.50	3.70	3.74	4.10	4.217
Aug.	1.85	1.90	1.80	1.90	1.95	1.61	1.60	1.60	1.60	1.80	1.80	1.90	2.25	2.10	2.25	2.50	2.95	3.50	3.40	3.50	3.70	3.90	4.10	4.225
Sept.	1.80	1.90	1.78	1.90	1.95	1.60	1.60	1.60	1.60	1.80	1.80	1.90	2.25	2.10	2.25	2.50	2.95	3.50	3.40	3.50	3.70	3.90	4.10	4.225
Oct.	1.80	1.90	1.75	1.90	1.94	1.60	1.60	1.60	1.70	1.80	1.80	1.90	2.25	2.10	2.25	2.50	2.95	3.50	3.40	3.50	3.70	3.90	4.10	4.225
Nov.	1.86	1.90	1.77	1.90	1.90	1.60	1.60	1.60	1.70	1.80	1.80	1.90	2.25	2.10	2.25	2.50	2.95	3.50	3.40	3.50	3.70	3.90	4.10	4.225
Dec.	1.90	1.90	1.80	1.90	1.90	1.60	1.54	1.60	1.70	1.80	1.80	1.90	2.25	2.10	2.25	2.50	2.95	3.50	3.44	3.70	3.70	3.90	4.10	4.225
Avg.	1.92	1.88	1.82	1.87	1.93	1.69	1.62	1.56	1.61	1.78	1.80	1.85	2.21	2.17	2.21	2.47	2.88	3.19	3.43	3.52	3.70	3.79	4.01	4.182

* 1939-1944 = 2.10¢.

STRUCTURAL SHAPES Cents Per Pound, at Pittsburgh

	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923
Jan.	2.25	1.50	1.60	1.60	1.60	1.60	1.70	1.70	1.70	1.60	1.56	1.40	1.15	1.75	1.20	1.10	1.90	3.25	3.00	2.80	2.47	2.45	1.90	2.06
Feb.	2.25	1.50	1.60	1.60	1.60	1.50	1.70	1.70	1.70	1.52	1.51	1.40	1.11	1.71	1.20	1.10	2.06	3.25	3.00	2.80	2.70	2.25	1.39	2.29
Mar.	2.25	1.52	1.70	1.60	1.60	1.60	1.70	1.70	1.70	1.30	1.50	1.40	1.15	1.70	1.19	1.10	2.40	3.54	3.00	2.71	3.13	2.00	1.39	2.39
Apr	2.25	1.60	1.70	1.60	1.60	1.60	1.70	1.70	1.70	1.27	1.50	1.40	1.21	1.68	1.15	1.20	2.55	3.86	3.00	2.45	3.25	2.10	1.50	2.50
May	2.25	1.60	1.60	1.60	1.60	1.60	1.70	1.70	1.70	1.27	1.50	1.39	1.25	1.60	1.14	1.20	2.60	4.00	3.00	2.45	3.10	2.20	1.56	2.50
June	2.07	1.60	1.60	1.60	1.60	1.60	1.70	1.70	1.62	1.25	1.46	1.35	1.26	1.45	1.11	1.20	2.53	4.31	3.00	2.45	3.10	2.10	1.63	2.50
July	1.90	1.60	1.64	1.60	1.60	1.60	1.70	1.70	1.60	1.33	1.41	1.35	1.30	1.45	1.12	1.25	2.50	4.50	3.00	2.45	3.10	1.93	1.70	2.50
Aug.	1.74	1.60	2.00	1.60	1.60	1.63	1.70	1.70	1.60	1.40	1.41	1.35	1.35	1.46	1.19	1.30	2.52	4.30	3.00	2.45	3.10	1.82	1.88	2.50
Sept.	1.50	1.60	2.00	1.60	1.44	1.70	1.70	1.70	1.60	1.46	1.40	1.34	1.42	1.41	1.20	1.35	2.64	4.00	3.00	2.45	3.10	1.84	2.00	2.50
Oct.	1.50	1.60	2.07	1.60	1.40	1.70	1.70	1.70	1.60	1.50	1.40	1.21	1.48	1.37	1.18	1.44	2.75	3.00	3.00	2.45	3.05	1.80	2.00	2.50
Nov.	1.50	1.60	2.00	1.60	1.40	1.70	1.70	1.70	1.60	1.54	1.40	1.13	1.57	1.29	1.10	1.60	2.86	3.00	3.00	2.45	2.89	1.84	2.00	2.50
Dec.	1.50	1.60	2.00	1.60	1.44	1.70	1.70	1.70	1.60	1.55	1.40	1.15	1.60	1.25	1.07	1.70	3.25	3.00	2.90	2.45	2.45	1.90	2.00	2.50
Avg.	1.91	1.56	1.81	1.62	1.54	1.62	1.70	1.70	1.64	1.42	1.45	1.32	1.32	1.50	1.15	1.31	2.65	3.67	2.99	2.53	2.95	1.94	1.71	2.43

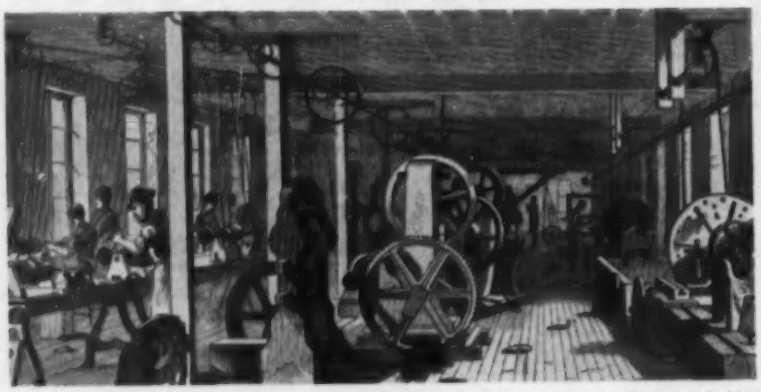
	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1939*	1945	1947	1948	1949	1950	1951	1952	1953	1954
Jan.	2.00	2.10	1.90	1.90	1.81	1.90	1.83	1.84	1.50	1.60	1.70	1.80	1.80	2.05	2.25	2.10	2.50	2.80	3.25	3.40	3.65	3.65	3.85	4.10
Feb.	2.00	2.10	1.90	1.90	1.85	1.90	1.80	1.65	1.50	1.60	1.70	1.80	1.80	2.06	2.25	2.23	2.50	2.80	3.25	3.40	3.65	3.65	3.85	4.10
Mar.	2.20	2.10	1.90	1.90	1.85	1.90	1.80	1.65	1.52	1.60	1.70	1.80	1.80	2.21	2.25	2.35	2.50	2.80	3.25	3.40	3.65	3.65	3.85	4.10
Apr	2.20	2.05	1.90	1.88	1.85	1.95	1.80	1.65	1.60	1.60	1.74	1.80	1.80	2.25	2.25	2.35	2.50	2.80	3.25	3.40	3.65	3.65	3.85	4.10
May	2.24	2.00	1.90	1.80	1.85	1.95	1.73	1.65	1.60	1.60	1.85	1.80	1.80	2.25	2.25	2.35	2.50	2.75	3.25	3.40	3.65	3.65	3.85	4.10
June	2.20	2.00	1.94	1.90	1.85	1.95	1.80	1.60	1.60	1.60	1.85	1.80	1.80	2.25	2.22	2.35	2.50	2.75	3.25	3.40	3.65	3.65	3.90	4.10
July	2.09	2.00	2.00	1.80	1.85	1.95	1.65	1.63	1.60	1.60	1.81	1.80	1.90	2.25	2.10	2.35	2.50	2.85	3.25	3.40	3.65	3.69	4.10	4.24
Aug.	2.00	1.95	2.00	1.80	1.90	1.95	1.61	1.60	1.60	1.60	1.80	1.80	1.90	2.25	2.10	2.35	2.80	3.25	3.25	3.40	3.65	3.65	4.10	4.25
Sept.	2.00	1.90	2.00	1.78	1.90	1.95	1.60	1.60	1.60	1.60	1.80	1.80	1.90	2.25	2.10	2.35	2.80	3.25	3.25	3.40	3.65	3.65	4.10	4.25
Oct.	1.93	1.90	2.00	1.75	1.90	1.90	1.60	1.60	1.60	1.70	1.80	1.80	1.90	2.25	2.10	2.35	2.80	3.25	3.25	3.40	3.65	3.65	4.10	4.25
Nov.	2.00	1.90	2.00	1.77	1.90	1.90	1.60	1.60	1.60	1.70	1.80	1.80	1.90	2.25	2.10	2.35	2.80	3.25	3.25	3.40	3.65	3.65	4.10	4.25
Dec.	2.10	1.90	2.00	1.80	1.90	1.90	1.60	1.50	1.60	1.70	1.80	1.80	1.90	2.25	2.10	2.35	2.80	3.25	3.31	3.65	3.65	3.85	4.10	4.25
Avg.	2.19	1.99	1.95	1.83	1.87	1.93	1.69	1.62	1.56	1.63	1.78	1.80	1.85	2.21	2.17	2.32	2.63	3.00	3.26	3.42	3.65	3.74	3.96	4.17

* 1939-1945 = 2.10¢.

COLD FINISHED BARS Cents Per Pound, at Pittsburgh

	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939*	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954
Jan.	3.60	3.60	1.94	2.53	3.00	2.80	2.50	2.30	2.20	1.90	2.15	2.00	2.00	1.70	2.10	2.10	2.10	2.55	2.00	2.70	2.65	2.75	3.20	3.55	3.90	4.145	4.55	4.55	4.925	5.20
Feb.	3.55	3.60	1.90	2.73	2.95	2.80	2.50	2.30	2.20	1.90	2.10	2.10	2.00	1.70	2.10	2.10	2.10	2.55	2.00	2.70	2.65	2.93	3.20	3.55	3.90	4.145	4.55	4.55	4.925	5.20
Mar.	3.00	3.20	1.80	2.55	2.80	2.72	2.50	2.35	2.20	1.90	2.10	2.10	2.00	1.70	2.10	2.10	2.10	2.53	2.00	2.70	2.65	3.10	3.20	3.55	3.90	4.145	4.55	4.55	4.925	5.20
Apr.	3.00	3.05	1.85	3.00	3.00	2.70	2.50	2.40	2.20	1.95	2.10	2.10	2.00	1.70	2.10	2.01	2.10	2.00	2.00	2.70	2.65	3.10	3.20	3.55	3.90	4.145	4.55	4.55	4.925	5.20
May	3.00	3.10	1.94	3.25	2.90	2.70	2.50	2.40	2.20	1.95	2.10	2.10	1.82	1.70	2.10	1.95	2.10	2.00	2.00	2.60	2.65	3.10	3.20	3.50	3.90	4.145	4.55	4.55	4.925	5.20
June	3.00	3.00	2.03	3.25	2.90	2.80	2.50	2.33	2.20	1.95	2.10	2.10	1.70	1.70	2.10	1.95	2.10	2.00	2.70	2.65	2.65	3.10	3.20	3.50	3.90	4.145	4.55	4.55	5.041	5.20
July	6.00	2.80	2.10	3.25	2.84	2.60	2.50	2.20	2.10	1.95	2.10	2.10	1.70	1.70	2.10	1.95	2.25	2.00	2.70	2.65	2.65	3.10	3.27	3.82	3.90	4.145	4.55	4.025	5.20	5.39
Aug.	6.00	2.40	2.23	3.25	2.80	2.80	2.50	2.20	2.10	1.95	2.10	2.10	1.70	1.70	2.10	1.95	2.25	2.00	2.70	2.65	2.73	3.10	3.55	3.90	3.90	4.145	4.55	4.925	5.20	5.40
Sept.	4.60	2.30	2.50	3.25	2.74	2.40	2.50	2.15	2.10	1.94	2.10	2.10	1.70	1.95	2.10	1.95	2.25	2.00	2.70	2.65	2.75	3.10	3.55	3.90	3.90	4.145	4.55	4.925	5.20	5.40
Oct.	4.00	2.10	2.50	3.10	2.70	2.40	2.40	2.10	2.10	1.90	2.10	2.10	1.70	1.95	2.10	1.95	2.35	2.00	2.70	2.65	2.75	3.10	3.55	3.90	3.90	4.145	4.55	4.925	5.20	5.40
Nov.	3.92	2.09	2.50	2.95	2.70	2.40	2.30	2.10	2.20	1.90	2.09	2.10	1.70	1.95	2.10	1.95	2.35	2.00	2.70	2.65	2.75	3.10	3.55	3.90	3.90	4.15	4.55	4.925	5.20	5.40
Dec.	3.60	2.00	2.50	3.00	2.75	2.50	2.30	2.10	2.20	1.90	2.00	2.02	1.70	2.10	2.10	1.95	2.35	2.00	2.70	2.65	2.75	3.10	3.55	3.90	4.01	4.55	4.55	4.925	5.20	5.40
Avg.	4.04	2.77	2.15	3.03	2.86	2.61	2.46	2.25	2.17	1.92	2.09	2.09	1.81	1.80	2.10	1.99	2.20	2.04	2.78	2.67	2.69	3.06	3.35	3.74	3.98	4.179	4.55	4.712	5.072	5.30

* 1940-1944—2.65¢.



PUNCH PRESS manufacturing plant of the 1880's. Note use of line shafts and belts, virtual absence of materials handling equipment.

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HOT ROLLED BARS Cents Per Pound, at Pittsburgh

	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924
Jan.	2.22	1.25	1.50	1.60	1.30	1.40	1.50	1.60	1.00	1.40	1.50	1.40	1.15	1.70	1.20	1.10	2.03	3.15	2.90	2.70	2.75	2.35	1.50	2.04	2.40
Feb.	2.21	1.30	1.51	1.60	1.30	1.40	1.50	1.60	1.60	1.35	1.50	1.40	1.12	1.70	1.20	1.10	2.31	3.25	2.90	2.70	3.00	2.15	1.39	2.20	2.40
Mar.	2.25	1.40	1.60	1.60	1.33	1.50	1.50	1.60	1.60	1.20	1.45	1.40	1.10	1.85	1.20	1.15	2.65	3.63	2.90	2.61	3.83	2.00	1.39	2.39	2.40
Apr.	2.10	1.47	1.60	1.60	1.35	1.50	1.50	1.60	1.60	1.15	1.45	1.40	1.16	1.84	1.15	1.20	2.90	3.75	2.90	2.35	3.75	2.05	1.50	2.50	2.29
May	1.91	1.41	1.60	1.60	1.35	1.50	1.50	1.60	1.60	1.10	1.45	1.37	1.20	1.70	1.14	1.20	3.00	4.00	2.90	2.35	3.63	2.10	1.58	2.40	2.24
June	1.52	1.40	1.60	1.60	1.38	1.46	1.50	1.60	1.45	1.20	1.45	1.25	1.20	1.80	1.11	1.21	2.75	4.25	2.90	2.35	3.50	2.05	1.70	2.40	2.20
July	1.19	1.40	1.60	1.60	1.38	1.50	1.50	1.60	1.40	1.27	1.45	1.23	1.23	1.80	1.12	1.25	2.63	4.50	2.90	2.35	3.50	1.84	1.70	2.40	2.15
Aug.	1.05	1.44	.60	1.60	1.38	1.50	1.50	1.60	1.40	1.32	1.40	1.20	1.30	1.40	1.19	1.30	2.50	4.30	2.90	2.35	3.25	1.74	1.88	2.40	2.13
Sept.	1.12	1.50	1.60	1.60	1.31	1.50	1.50	1.60	1.40	1.39	1.40	1.19	1.37	1.40	1.20	1.34	2.60	4.00	2.90	2.35	3.25	1.63	2.00	2.40	2.04
Oct.	1.00	1.53	1.60	1.60	1.30	1.50	1.50	1.60	1.40	1.51	1.40	1.12	1.45	1.39	1.15	1.44	2.75	2.90	2.90	2.30	3.13	1.56	2.00	2.40	2.00
Nov.	1.16	1.50	1.50	1.37	1.31	1.50	1.54	1.60	1.40	1.50	1.40	1.08	1.55	1.29	1.10	1.82	2.63	2.90	2.90	2.09	2.87	1.50	2.00	2.40	2.03
Dec.	1.25	1.50	1.60	1.30	1.34	1.50	1.60	1.60	1.40	1.50	1.40	1.12	1.60	1.21	1.07	1.84	3.00	2.90	2.90	2.75	2.35	1.50	2.00	.240	2.10
Avg.	1.88	1.43	1.58	1.56	1.33	1.48	1.51	1.60	1.49	1.33	1.44	1.26	1.29	1.55	1.15	1.31	2.67	3.63	2.90	2.50	3.22	1.87	1.72	2.36	2.20

	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939*	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954
Jan.	2.10	2.00	1.90	1.81	1.90	1.90	1.84	1.50	1.60	1.75	1.80	1.85	2.20	2.45	2.25	2.15	2.25	2.60	2.90	3.40	3.45	3.70	3.70	3.95	4.15
Feb.	2.10	2.00	1.90	1.85	1.90	1.85	1.85	1.50	1.60	1.75	1.80	1.85	2.20	2.45	2.25	2.15	2.30	2.60	2.90	3.45	3.45	3.70	3.70	3.95	4.15
Mar.	2.10	2.00	1.90	1.85	1.90	1.85	1.85	1.52	1.60	1.75	1.80	1.85	2.40	2.45	2.25	2.15	2.50	2.60	2.90	3.43	3.45	3.70	3.70	3.95	4.15
Apr.	2.05	2.00	1.90	1.85	1.95	1.79	1.85	1.60	1.60	1.79	1.80	1.85	2.45	2.45	2.25	2.15	2.50	2.60	2.90	3.35	3.45	3.70	3.70	3.95	4.15
May	2.00	1.85	1.85	1.85	1.95	1.75	1.85	1.60	1.60	1.90	1.80	1.85	2.45	2.45	2.15	2.17	2.50	2.60	2.87	3.35	3.45	3.70	3.70	3.95	4.15
June	2.00	2.00	1.81	1.85	1.95	1.73	1.85	1.60	1.60	1.90	1.80	1.85	2.45	2.41	2.15	2.25	2.50	2.60	2.87	3.35	3.45	3.70	3.70	4.04	4.15
July	2.00	2.00	1.80	1.85	1.95	1.85	1.83	1.60	1.60	1.82	1.80	1.95	2.45	2.25	2.15	2.25	2.50	2.60	3.00	3.35	3.45	3.70	3.75	4.15	4.29
Aug.	1.95	2.00	1.80	1.80	1.85	1.84	1.80	1.60	1.60	1.80	1.80	1.95	2.45	2.25	2.15	2.25	2.50	2.90	3.45	3.35	3.45	3.70	3.95	4.15	4.30
Sept.	1.92	2.00	1.75	1.75	1.94	1.81	1.80	1.60	1.60	1.80	1.80	1.87	2.45	2.25	2.15	2.25	2.50	2.90	3.45	3.35	3.45	3.70	3.95	4.15	4.30
Oct.	2.00	2.00	1.75	1.75	1.90	1.80	1.80	1.75	1.80	1.86	2.05	2.45	2.25	2.15	2.25	2.50	2.90	3.45	3.35	3.45	3.70	3.95	4.15	4.30
Nov.	2.00	2.00	1.77	1.77	1.90	1.80	1.80	1.80	1.75	1.80	1.85	2.05	2.45	2.25	2.15	2.25	2.50	2.90	3.45	3.39	3.45	3.70	3.95	4.15	4.30
Dec.	2.00	2.00	1.80	1.80	1.90	1.80	1.80	1.80	1.75	1.80	1.85	2.05	2.45	2.25	2.15	2.25	2.50	2.90	3.45	3.35	3.79	3.70	3.95	4.15	4.30
Avg.	2.02	2.00	1.84	1.82	1.92	1.71	1.83	1.57	1.64	1.81	1.81	1.93	2.40	2.33	2.19	2.21	2.47	2.73	3.13	3.37	3.47	3.70	3.79	4.06	4.22

* 1940-1944—2.15¢.



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BOLT MAKING room in a nut and bolt plant of the 1880's. Automatic machines, right of center, dumped their output directly on the floor.

HIGH SPEED TOOL STEEL Type 18-4-1, Cents Per Pound

	1936	1937*	1946	1947	1948†	1949	1950	1951	1952	1953	1954
Jan.	57.00	80.00	67.00	72.494	82.0	90.5	100.0	116.8	150.5	157.57	182.50
Feb.	57.00	67 00	67.00†	72.494	82.0	90.5	110.0	123.5	150.5	157.57	148.00
Mar.	57.00	67 00	67.00†	72.494	82.0	90.5	100.0	123.5	150.5	157.57	148.00
Apr.	57.00	67.00	67.00†	74.00	82.0	90.5	100.0	123.5	150.5	157.57	148.00
May	56 00	67 00	67.00†	74.00	82.0	90.5	100.0	123.5	150.5	157.57	148.00
June	55 00	67.00	67.00†	74.00	82.0	90.5	100.0	123.5	150.5	161.11	148.00
July	57.00	67.00	67.00†	74.00	82.0	90.5	100.0	123.5	161.91	166.00	161.00
Aug.	57.50	67.00	67.00†	82.00	90.5	90.5	100.0	150.5	157.57	166.00	164.00
Sept.	57.50	80.00	67.00†	82.00	90.5	90.5	100.0	150.5	157.57	166.00	164.00
Oct.	57.50	80.00	67.00†	82.00	90.5	90.5	100.0	150.5	157.57	166.00	164.00
Nov.	57.50	80.00	67.00†	82.00	90.5	90.5	100.0	150.5	157.57	166.00	164.00
Dec.	58.00	80.00	67.00†	82.50	90.5	90.5	110.0	150.5	157.57	166.00	164.00
Avg.	56.92	72.42	67.00†	75.58	85.5	90.5	100.5	134.19	153.06	162.08	161.13

* 1938-1945—67.00. † Increase of 8.2 pct applies to base price since Feb. 15, 1946.

STEEL RAILS Dollars Per 100 lb, at Mill

	1900*	1901	1902	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1932	1933	1934
Jan.	$1.56	$1.16	to	$1.34	$1.34	$1.34	$1.79	$2.54	$2.54	$2.10	$2.10	$1.79	to	$1.92	$1.79	$1.82
Feb.	1.62	1.16	1913	1.34	1.34	1.34	1.79	2.54	2.54	2.10	2.10	1.79	1931	1.92	1.79	1.62
Mar.	1.56	1.16	incl.	1.34	1.34	1.34	1.79	2.54	2.43	2.21	2.10	1.79	incl.	1.92	1.79	1.62
Apr.	1.56	1.22	$1.25	1.34	1.34	1.34	1.79	2.54	2.10	2.54	2.10	1.79	$1.92	1.92	1.79	1.62
May	1.56	1.25		1.34	1.34	1.56	1.79	2.54	2.10	2.54	2.10	1.79		1.92	1.79	1.62
June	1.56	1.25		1.34	1.34	1.56	1.79	2.54	2.10	2.54	2.10	1.79		1.92	1.79	1.62
July	1.56	1.25		1.34	1.34	1.56	1.79	2.54	2.10	2.54	2.10	1.79		1.92	1.79	1.62
Aug.	1.56	1.25		1.34	1.34	1.56	1.79	2.54	2.10	2.54	2.10	1.79		1.92	1.79	1.62
Sept.	1.43	1.25		1.34	1.34	1.56	1.79	2.54	2.10	2.54	2.10	1.79		1.92	1.79	1.62
Oct.	1.16	1.25		1.34	1.34	1.56	....	2.54	2.10	2.54	2.02	1.92		1.87	1.77	1.62
Nov.	1.16	1.25		1.34	1.34	1.70	....	2.54	2.10	2.54	1.79	1.92		1.79	1.62	1.62
Dec.	1.16	1.25		1.34	1.34	1.79	....	2.54	2.10	2.37	1.79	1.92		1.79	1.62	1.62
Avg.	1 45	1 23	1.25	1.34	1.34	1.52	1.79	2.54	2.20	2.43	2.04	1.92	1.92	1.89	1.75	1.62

	1935	1936	1937	1938	1939	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954
Jan.	$1.62	$1.62	$1.74	$1.89	to	$1.79	$1.92	$2.06	$2.75	$3.20	$3.40	$3.60	$3.60	$3.775	$4.325
Feb.	1.62	1.62	1.74	1.89	1944	1.79	1.93	2.06	2.75	3.20	3.40	3.60	3.60	3.775	4.325
Mar.	1.62	1.62	1.87	1.89	incl.	1.87	2.17	2.06	2.75	3.20	3.40	3.60	3.60	3.775	4.325
Apr.	1.62	1.62	1.89	1.89	$1.79	1.92	2.17	2.06	2.75	3.20	3.40	3.60	3.60	3.775	4.325
May	1.62	1.62	1.89	1.89		1.92	2.17	2.50	2.75	3.20	3.40	3.60	3.60	3.991	4.325
June	1.62	1.62	1.89	1.89		1.92	2.17	2.50	2.75	3.20	3.40	3.60	3.60	4.181	4.325
July	1.62	1.62	1.89	1.89		1.92	2.17	2.50	2.90	3.20	3.40	3.60	3.635	4.325	4.442
Aug.	1.62	1.62	1.89	1.89		1.92	2.17	2.75	3.20	3.20	3.40	3.60	3.775	4.325	4.445
Sept.	1.62	1.62	1.89	1.84		1.92	2.17	2.75	3.20	3.20	3.40	3.60	3.775	4.325	4.445
Oct.	1.62	1.62	1.89	1.79		1.92	2.17	2.75	3.20	3.20	3.40	3.60	3.775	4.325	4.445
Nov.	1.62	1.62	1.89	1.79		1.92	2.17	2.75	3.20	3.20	3.40	3.60	3.775	4.325	4.445
Dec.	1.62	1.74	1.89	1.79		1.92	2.37	2.75	3.20	3.28	3.60	3.60	3.775	4.325	4.445
Avg.	1.62	1.63	1.87	1.86	1.79	1.88	2.13	2.60	2.93	3.21	3.42	3.60	3.679	4.102	4.387

* Bessemer rails to end of 1913; openhearth rails 1914-1954.

NONFERROUS METALS

Prices of lake and electrolytic copper, straits tin, common grade lead, prime Western zinc and aluminum from 1900 through 1954.

LAKE AND ELECTROLYTIC COPPER Cents Per Pound, at New York

	1900*	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919
Jan.	16.21	16.90	11.45	12.13	12.62	15.10	18.75	24.41	13.90	14.56	14.00	12.81	14.80	16.98	14.85	14.02	24.38	29.73	23.50	20.46
Feb.	16.25	16.97	12.47	12.80	12.34	15.25	17.94	25.10	13.13	13.37	13.78	12.75	14.41	15.56	15.00	15.21	28.55	34.90	23.50	17.86
Mar.	16.41	17.00	12.12	14.31	12.66	15.25	18.50	23.38	12.65	12.90	13.75	12.58	14.56	15.05	14.79	15.75	27.10	35.85	23.50	15.46
Apr.	17.00	17.06	11.97	14.85	13.19	15.10	18.02	24.02	13.09	12.94	13.31	12.41	16.00	15.67	14.75	16.90	25.27	31.67	23.50	15.55
May	16.90	17.00	12.10	14.75	13.25	15.00	18.70	24.10	12.58	13.21	13.06	12.33	16.30	15.91	14.40	21.00	26.55	31.42	23.50	16.10
June	16.31	17.00	12.23	14.56	12.74	15.00	18.00	23.94	13.00	13.50	12.86	12.71	17.53	15.42	14.12	23.36	27.82	32.46	23.50	17.95
July	16.31	16.97	11.94	13.73	12.62	15.03	18.47	21.95	13.00	13.34	12.66	12.75	17.84	14.78	13.70	21.98	25.84	28.78	25.00	22.07
Aug.	16.55	16.50	11.80	13.35	12.50	16.07	18.65	18.94	13.71	13.56	12.93	12.75	17.73	15.08	12.65	19.33	25.95	27.24	26.00	23.16
Sept.	16.75	16.50	11.60	13.56	12.67	16.12	19.31	16.41	13.80	13.50	12.81	12.65	17.77	16.77	12.66	17.97	25.03	24.90	26.00	22.66
Oct.	16.73	16.71	11.71	13.42	13.00	16.62	21.81	13.50	13.81	13.19	12.84	12.53	17.86	16.85	11.73	17.89	25.40	23.50	26.00	22.13
Nov.	16.75	16.82	11.44	13.25	14.22	16.90	22.50	13.94	14.44	13.44	12.96	12.86	17.70	16.16	12.00	18.92	32.32	23.50	26.00	20.69
Dec.	16.87	14.71	11.61	12.30	14.67	16.75	23.06	13.48	14.53	13.50	13.00	13.04	17.69	14.66	13.35	20.24	33.38	23.50	25.40	18.90
Avg.	16.53	16.67	11.85	13.59	13.06	15.86	19.89	20.34	13.51	13.44	13.17	12.74	16.65	15.52	13.66	18.72	26.19	28.95	24.66	19.43

	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939
Jan.	19.27	12.85	13.55	14.02	12.46	14.73	13.84	12.98	13.55	18.99	17.75	9.79	7.12	4.75	7.92	8.75	9.00	12.41	10.18	11.00
Feb.	19.02	12.84	12.92	15.34	12.73	14.49	14.00	12.69	13.82	17.74	17.75	9.71	6.87	4.75	7.75	8.75	9.00	13.44	9.75	11.00
Mar.	18.50	12.19	12.68	16.84	13.52	14.06	13.86	13.06	13.90	21.25	17.75	9.52	5.76	5.00	7.75	8.75	9.00	15.75	9.75	11.00
Apr.	19.19	12.49	12.61	16.61	13.21	13.30	13.69	12.81	14.13	19.69	15.67	9.48	5.54	5.39	8.16	8.75	9.14	15.10	9.75	10.22
May	19.05	12.79	13.13	16.54	12.76	13.34	13.60	12.65	14.19	17.75	12.78	8.67	5.25	6.66	8.25	8.75	9.25	13.75	9.35	9.81
June	19.00	12.86	13.62	14.74	12.35	13.41	13.64	12.37	14.50	17.75	12.09	8.05	5.11	7.75	8.75	8.63	9.25	13.75	9.76	9.75
July	19.00	12.46	13.71	14.39	12.39	13.95	13.91	12.81	14.60	17.75	11.02	7.67	5.04	8.63	8.75	7.75	9.35	13.75	9.56	9.95
Aug.	19.00	11.70	13.74	13.97	13.26	14.48	14.19	13.00	14.50	17.75	10.66	7.26	5.16	8.75	8.75	7.92	9.50	13.75	9.87	10.24
Sept.	18.70	12.01	13.75	13.36	12.97	14.42	14.05	12.93	14.70	17.75	10.39	6.98	5.95	8.75	8.75	8.52	9.50	13.63	10.00	11.66
Oct.	18.56	12.67	13.66	12.66	12.96	14.29	13.86	12.98	15.16	17.75	9.80	8.75	5.72	7.97	8.75	8.94	9.54	11.81	10.74	12.19
Nov.	14.63	13.07	13.62	12.76	13.59	14.36	13.89	13.34	15.75	17.75	10.17	6.54	5.67	7.91	8.75	9.00	10.16	10.77	11.00	12.25
Dec.	13.63	13.55	14.00	12.88	14.23	13.82	13.31	13.79	15.75	17.75	10.29	6.98	4.75	7.87	8.75	9.00	10.73	9.98	11.00	12.25
Avg.	17.96	12.63	13.42	14.47	13.04	14.05	13.80	12.93	14.06	18.11	12.99	8.11	5.56	7.02	8.41	8.63	9.45	13.15	9.96	10.95

* Lake copper 1900–1919; electrolytic 1920–1939.

ELECTROLYTIC COPPER Cents Per Pound, Connecticut Valley

	1929	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940*	1946	1947	1948	1949	1950	1951	1952	1953	1954
Jan.	18.84	10.03	7.33	5.00	8.16	9.00	9.25	12.63	10.42	11.25	12.22	12.00	19.86	21.50	23.50	18.50	24.50	24.50	24.50	29.75
Feb.	18.86	9.99	8.25	5.00	8.00	9.00	9.25	13.75	10.00	11.25	11.40	12.00	19.75	21.50	23.50	18.50	24.50	24.50	25.41	29.75
Mar.	21.38	10.14	8.99	8.26	8.00	9.00	9.25	16.00	10.00	11.25	11.38	12.00	21.50	21.50	23.48	18.50	24.50	24.50	30.56	29.87
April	19.93	9.88	8.79	8.58	8.39	9.00	9.40	16.13	10.00	10.47	11.33	12.00	21.50	21.50	21.72	18.94	24.50	24.50	30.70	29.97
May	18.00	8.94	8.51	8.93	8.50	9.00	9.50	14.00	9.69	10.06	11.32	12.00	22.63	21.50	19.86	19.92	24.50	24.50	29.85	30.00
June	18.00	8.31	8.39	8.00	8.02	8.88	9.50	14.00	9.00	10.00	11.37	14.28	21.63	21.50	18.86	22.27	24.50	24.50	29.00	30.00
July	18.00	7.98	8.28	8.91	9.00	8.00	9.00	14.00	9.01	10.22	10.81	14.375	21.50	21.50	17.33	22.00	24.50	24.50	29.00	30.00
Aug.	18.00	7.52	8.43	9.00	9.00	8.22	9.75	14.00	10.12	10.49	10.95	14.375	21.50	23.43	17.63	22.84	24.50	24.50	29.39	30.00
Sept.	18.03	7.26	8.21	9.00	9.00	8.77	9.75	13.75	10.25	11.93	11.54	14.375	21.50	23.50	17.63	23.25	24.50	24.50	29.50	30.00
Oct.	18.00	7.01	8.97	8.25	9.00	9.19	9.85	12.13	10.06	12.44	12.00	14.375	21.50	23.50	17.63	24.50	24.50	24.50	29.61	30.00
Nov.	18.00	6.88	8.31	8.16	9.00	9.25	10.43	11.06	11.25	12.50	12.00	17.19	21.50	23.50	18.42	24.50	24.50	24.50	29.75	30.00
Dec.	18.00	6.88	8.049	8.12	9.00	9.25	11.00	10.25	11.25	12.50	12.00	19.50	21.50	23.50	18.50	24.50	24.50	24.50	29.75	30.00
Avg.	18.35	8.37	8.7	7.28	8.66	8.86	9.71	13.39	10.22	11.20	11.63	14.04	21.30	22.33	19.81	21.84	24.50	24.50	29.07	29.95

* 1941–1945 incl.: 12.00.

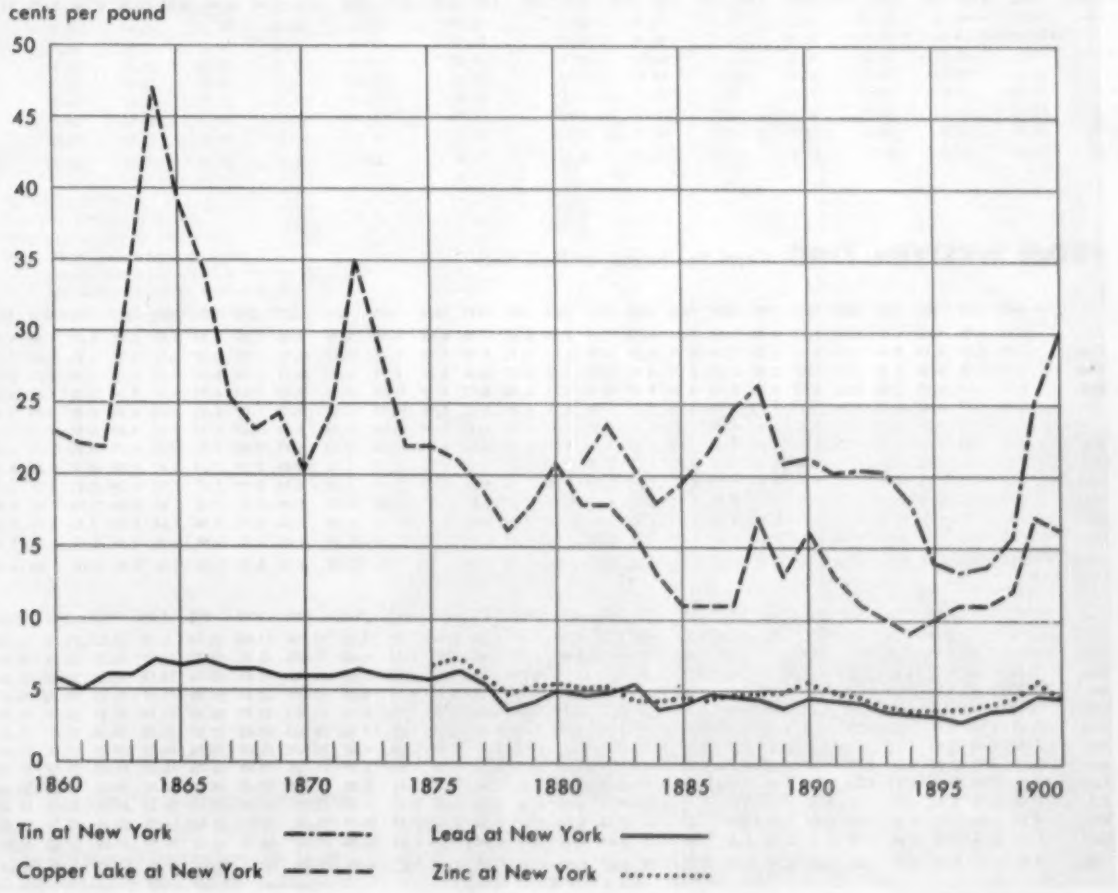
STRAITS TIN Prompt, Cents Per Pound, at New York

	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925
Jan.	28.00	26.60	23.38	27.76	28.75	29.18	36.36	42.14	27.43	28.19	32.61	41.20	44.88	50.34	39.12	34.13	41.76	44.10	65.13	71.50	62.74	35.94	33.03	39.16	48.70	58.26
Feb.	29.71	26.56	24.73	29.14	27.98	29.49	36.48	42.16	28.74	28.44	32.65	43.34	43.56	48.71	39.83	37.25	42.60	51.47	65.00	72.45	59.87	32.16	33.74	41.98	53.41	57.09
Mar.	32.42	25.95	26.16	30.06	28.19	29.21	38.62	41.29	30.48	28.75	32.51	41.10	42.76	48.93	38.03	48.73	50.53	58.38	65.00	72.50	61.93	28.79	29.14	40.61	58.03	53.67
Apr.	30.85	25.94	27.29	29.69	27.99	30.43	38.06	40.84	31.70	29.35	32.53	42.05	43.64	48.04	36.10	47.64	51.51	55.82	66.53	72.50	62.12	33.36	33.98	45.84	50.02	52.27
May	29.25	26.62	29.26	29.26	27.75	30.04	43.08	43.01	29.64	29.07	33.66	43.32	45.86	48.06	33.21	38.79	46.14	63.21	100.00	72.50	54.99	32.50	30.92	43.11	44.06	54.65
June	30.00	28.22	29.29	28.30	26.14	30.38	38.97	42.65	28.18	29.26	32.76	46.25	47.44	45.01	30.80	40.26	42.07	61.93	91.00	71.83	48.34	29.39	31.46	40.97	42.74	55.93
July	32.78	27.41	29.28	27.80	26.26	31.71	37.18	41.15	28.92	29.05	32.96	43.23	44.70	41.32	35.65	37.38	38.25	62.61	93.00	70.11	46.29	27.69	31.67	38.47	48.29	55.05
Aug.	31.13	28.90	28.14	28.00	28.74	32.85	38.90	37.35	29.90	29.96	33.92	43.38	45.98	41.63	48.34	34.37	38.88	62.53	91.33	62.20	47.60	28.36	32.36	39.33	51.89	56.12
Sept.	29.83	25.04	28.56	27.06	27.27	32.21	40.32	37.22	28.91	30.00	35.17	39.69	48.16	42.63	31.13	33.13	38.66	61.94	80.40	59.79	44.43	28.70	32.36	41.80	48.24	56.27
Oct.	28.48	24.62	25.76	25.63	28.53	32.47	42.90	32.33	29.44	30.41	36.76	41.23	50.07	40.36	30.25	33.05	41.10	62.24	78.52	54.52	40.47	27.70	34.61	41.80	50.60	62.24
Nov.	28.10	27.47	25.43	25.35	29.00	33.46	42.70	30.81	30.43	30.74	37.38	43.06	48.87	38.75	33.28	38.80	44.12	74.16	73.67	54.17	36.97	28.83	36.70	44.06	54.26	63.30
Dec.	28.84	24.39	25.33	27.53	29.27	35.84	42.62	27.92	29.13	32.91	38.21	45.03	49.86	37.12	34.01	38.53	42.56	84.74	71.51	53.80	34.04	32.41	37.48	47.16	56.03	62.94
Avg.	29.60	26.33	26.63	27.97	27.66	31.44	38.67	38.24	29.44	29.88	34.24	42.74	46.46	44.33	35.80	38.56	43.43	61.90	85.25	65.08	50.23	29.91	32.51	42.00	50.19	57.90

	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941†	1948	1947	1948	1949	1950	1951	1952	1953	1954
Jan.	62.20	66.43	55.56	49.21	38.84	29.03	21.80	22.70	51.98	50.91	47.23	50.90	41.54	46.39	48.73	50.16	52.00	70.00	94.00	$1.03	75.75	$1.72	$1.087	$1.215	94.83
Feb.	63.65	69.05	52.47	49.39	38.63	26.27	21.97	23.51	51.75	48.90	47.94	52.10	41.23	45.64	46.85	51.41	52.00	70.00	94.00	$1.03	74.90	$1.83	$1.215	$1.215	85.04
Mar.	64.47	69.23	52.11	48.85	36.76	27.02	21.81	24.35	53.94	48.88	48.60	52.74	41.18	46.17	47.07	52.07	52.00	70.00	94.00	$1.03	75.62	$1.45	$1.215	$1.214	91.88
Apr.	63.35	67.98	52.28	48.93	35.90	25.13	19.17	27.16	55.66	50.05	48.97	50.02	38.41	47.16	48.96	52.03	52.00	80.00	94.00	$1.03	76.36	$1.46	$1.215	$1.011	96.13
May	62.36	67.47	51.53	43.98	32.16	23.16	20.90	35.94	53.57	51.10	46.31	55.84	38.63	48.00	51.51	52.18	52.00	80.00	94.00	$1.03	77.50	$1.40	$1.215	97.50	93.51
June	60.63	67.42	47.92	44.20	30.26	23.53	19.56	44.23	51.31	51.08	42.24	55.90	40.36	48.81	54.64	52.66	52.00	80.00	$1.03	$1.03	77.70	$1.16	$1.215	92.92	94.19
July	62.98	64.01	47.01	46.29	29.76	24.98	20.89	46.26	51.94	52.31	42.86	59.34	43.26	48.53	51.61	53.41	52.00	80.00	$1.03	$1.03	88.86	$1.06	$1.215	$1.90	96.54
Aug.	65.17	64.41	47.57	48.60	30.00	25.73	22.98	44.71	51.99	50.46	42.57	59.40	43.26	48.80	51.21	52.45	52.00	80.00	$1.03	$1.03	$1.02	$1.03	$1.212	80.71	93.30
Sept.	66.59	61.43	48.06	45.32	29.59	24.51	24.76	48.46	51.52	49.05	44.77	58.84	43.40	Nom.	50.30	52.00	52.00	80.00	$1.03	$1.02	$1.01	$1.03	$1.213	82.38	93.52
Oct.	70.36	58.49	48.99	42.26	26.76	22.72	23.91	47.95	51.01	51.25	44.85	51.82	45.25	55.68	51.50	52.00	52.00	80.00	$1.03	95.49	$1.13	$1.03	$1.212	80.98	93.06
Nov.	70.75	57.49	50.76	40.16	25.87	22.76	23.31	53.14	51.24	51.68	51.30	43.34	46.29	52.65	50.57	52.00	61.00	80.00	$1.03	90.11	$1.36	$1.03	$1.213	83.11	91.14
Dec.	68.66	58.54	50.23	39.87	25.01	21.28	22.70	52.91	50.92	49.77	51.85	42.96	46.21	51.40	50.11	52.00	70.00	85.38	$1.03	79.06	$1.45	$1.03	$1.215	84.61	88.87
Avg.	64.29	64.32	50.39	45.16	31.62	24.43	21.86	39.12	52.23	50.39	46.42	54.29	42.28	48.11	49.84	52.03	54.00	77.95	99.26	99.22	95.53	$1.27	$1.201	95.79	91.82

† 1942-1945, incl.: 82.00.

Copper, Lead, Tin and Zinc Prices
1860-1900



COMMON GRADE LEAD Cents Per Pound, at New York

	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925
Jan.	4.70	4.37	4.02	4.19	4.39	4.56	5.06	6.30	3.75	4.19	4.70	4.50	4.41	4.35	4.11	3.74	5.62	7.69	6.87	5.56	6.67	5.00	4.70	7.55	8.31	10.25
Feb.	4.70	4.37	4.10	4.10	4.48	4.50	5.06	6.31	3.75	4.07	4.63	4.46	4.00	4.35	4.06	3.82	6.23	8.13	7.04	5.05	6.06	4.54	4.70	8.14	9.01	9.36
Mar.	4.70	4.37	4.10	4.44	4.56	4.45	5.35	6.31	3.85	4.02	4.51	4.41	4.00	4.35	3.97	4.04	7.43	9.47	7.24	5.23	9.21	4.00	4.71	8.47	9.23	8.90
Apr.	4.70	4.37	4.10	4.50	4.50	4.50	5.39	6.16	4.02	4.19	4.40	4.44	4.20	4.40	3.82	4.20	7.73	9.43	6.95	5.03	8.95	4.33	5.13	8.19	8.19	8.01
May	4.22	4.37	4.10	4.37	4.48	4.50	5.50	6.02	4.25	4.32	4.37	4.40	4.20	4.37	3.90	4.25	7.45	11.00	6.88	5.05	8.55	4.89	5.81	7.39	7.27	8.08
June	3.90	4.37	4.10	4.25	4.22	4.51	5.04	5.75	4.45	4.30	4.38	4.46	4.50	4.35	3.90	5.09	6.87	11.88	7.55	5.34	8.48	4.86	5.73	7.14	7.08	8.35
July	4.03	4.37	4.10	4.12	4.17	4.56	5.00	5.24	4.50	4.35	4.40	4.50	4.67	4.37	3.90	5.59	6.34	10.72	8.04	5.65	8.67	4.40	5.75	6.28	7.15	8.33
Aug.	4.25	4.37	4.10	4.12	4.15	4.64	5.75	5.12	4.50	4.36	4.40	4.50	4.54	4.64	3.87	4.66	5.28	10.72	8.05	5.77	8.66	4.40	5.66	6.74	6.82	9.82
Sept.	4.38	4.37	4.10	4.26	4.20	4.65	5.92	4.84	4.54	4.39	4.40	4.49	5.04	4.73	3.86	4.62	6.66	8.84	8.05	6.12	8.11	4.60	6.20	7.06	6.09	9.60
Oct.	4.37	4.37	4.10	4.40	4.20	5.07	5.84	4.84	4.34	4.39	4.40	4.31	5.06	4.62	3.62	4.60	7.60	8.77	8.05	6.45	7.24	4.70	6.67	6.84	6.31	9.62
Nov.	4.37	4.37	4.10	4.25	4.61	5.48	5.97	4.45	4.39	4.40	4.44	4.31	4.66	4.33	3.66	5.16	7.13	8.44	8.06	6.75	6.33	4.70	7.20	6.87	6.96	9.84
Dec.	4.37	4.19	4.10	4.19	4.60	5.96	6.19	3.76	4.24	4.56	4.60	4.45	4.32	4.06	3.80	5.33	7.60	8.48	6.71	7.03	4.60	4.70	7.28	7.61	9.61	9.36
Avg.	4.30	4.36	4.09	4.27	4.36	4.60	5.60	5.41	4.22	4.30	4.46	4.44	4.47	4.40	3.87	4.66	6.90	9.03	7.46	5.75	8.07	4.58	5.79	7.39	8.27	9.10

	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941*	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954
Jan.	5.25	7.50	6.50	6.65	6.25	4.50	3.75	3.00	4.00	3.60	4.50	6.00	4.87	4.63	5.47	5.50	6.50	13.00	15.00	21.50	12.00	17.00	19.00	14.10	13.26
Feb.	5.00	7.40	6.34	6.65	6.24	4.55	3.72	3.00	4.00	3.53	4.51	6.23	4.63	4.60	5.00	5.60	6.50	13.25	15.00	21.50	12.00	17.00	19.00	13.50	12.82
Mar.	8.46	7.57	6.00	7.41	6.66	4.53	3.15	3.15	4.00	3.50	4.60	7.10	4.50	4.62	5.19	5.77	6.50	15.00	15.00	18.98	10.96	17.00	19.00	13.40	12.94
Apr.	7.91	7.10	6.10	7.19	6.50	4.42	3.00	3.27	4.10	3.89	4.60	6.32	4.50	4.78	5.07	5.85	6.50	15.00	17.21	15.15	10.63	17.00	18.91	12.84	13.91
May	7.75	6.60	6.13	7.00	6.51	3.82	3.00	3.65	4.14	3.96	4.60	6.00	4.40	4.75	5.02	5.85	6.50	15.00	17.50	13.72	11.72	17.00	18.73	12.74	14.00
June	8.06	6.42	6.30	7.00	6.41	3.92	2.99	4.17	3.98	4.02	4.60	6.00	4.15	4.80	5.00	5.85	6.50	15.00	17.50	12.00	11.81	17.00	15.08	13.41	14.11
July	8.00	6.33	6.22	6.90	6.25	4.40	2.73	4.46	3.77	4.12	4.60	6.00	4.66	4.85	5.00	5.85	6.50	15.00	17.00	13.56	11.66	17.00	16.00	13.66	14.00
Aug.	8.96	6.66	6.26	6.75	6.49	4.40	3.24	4.50	3.75	4.25	4.60	6.45	4.60	5.04	4.85	5.85	6.50	15.00	16.50	14.99	12.93	17.00	16.00	14.00	14.06
Sept.	8.00	6.30	6.45	6.66	6.50	4.40	3.47	4.50	3.66	4.41	4.60	6.40	5.00	5.46	4.93	5.85	6.25	15.00	16.50	15.06	15.60	17.00	16.00	13.74	14.60
Oct.	8.40	6.26	6.50	6.87	6.17	3.97	3.66	4.32	3.66	4.51	4.83	5.75	5.10	5.50	5.31	5.85	6.25	15.00	16.50	13.42	16.00	16.83	14.40	13.50	14.96
Nov.	8.00	6.27	6.39	6.29	6.10	3.94	3.64	4.29	3.57	4.50	5.11	5.03	5.09	5.50	5.73	5.85	10.41	15.00	21.50	12.52	17.00	19.00	14.18	13.50	15.00
Dec.	7.87	6.52	6.49	6.25	6.10	3.80	3.60	4.14	3.60	4.50	5.56	4.87	4.84	5.50	5.50	5.86	12.20	15.00	21.50	12.60	17.00	19.00	14.13	13.50	15.00
Avg.	8.43	6.75	6.31	6.83	6.52	4.25	3.16	3.87	3.86	4.06	4.71	6.02	4.74	5.06	5.16	5.79	8.10	14.00	18.04	16.37	13.29	17.49	16.45	13.46	14.00

* 1942-1945 incl.: 6.50.

PRIME WESTERN ZINC Cents Per Pound, at New York

	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925
Jan.	4.55	4.00	4.26	4.02	4.95	6.17	6.48	6.90	4.04	5.15	6.26	5.55	6.02	7.15	5.29	6.99	15.19	9.94	7.66	7.36	9.62	5.83	6.06	7.28	6.76	8.10
Feb.	4.09	3.94	4.16	5.00	4.95	6.12	6.09	7.00	4.76	4.99	5.99	5.56	6.71	6.45	5.40	6.94	20.13	10.46	7.99	6.70	9.14	5.36	4.65	7.56	7.11	7.66
Mar.	4.60	3.89	4.29	5.36	5.06	6.06	5.96	6.92	4.75	4.81	5.72	5.65	6.66	6.26	5.26	9.29	18.40	10.77	7.64	6.52	8.93	5.20	5.00	8.19	6.65	7.66
Apr.	4.71	3.94	4.41	5.65	5.22	5.97	6.05	6.01	4.66	4.94	5.00	5.51	6.66	5.77	5.16	11.22	18.56	9.65	7.01	6.51	8.63	5.24	5.25	7.65	6.49	7.35
May	4.52	3.97	4.60	5.75	5.14	5.65	5.95	6.51	4.60	5.12	5.20	5.50	6.66	5.47	5.06	16.14	15.66	9.46	7.32	6.45	8.06	5.26	5.45	6.99	6.13	7.20
June	4.27	3.95	4.60	6.00	4.79	5.32	6.14	6.45	4.56	5.39	5.19	5.63	6.99	5.16	5.09	22.16	12.75	9.62	8.01	6.93	7.92	4.95	5.69	6.49	6.14	7.35
July	4.24	3.90	5.23	5.95	4.65	5.30	5.96	6.15	4.46	5.35	5.20	5.79	7.26	5.36	5.02	20.68	9.63	8.66	6.69	7.90	8.16	4.77	6.12	6.43	6.25	7.66
Aug.	4.17	3.92	5.46	5.94	4.66	5.60	6.06	5.71	4.71	5.74	5.26	6.04	7.19	5.75	5.60	14.11	8.96	8.69	6.96	7.64	8.31	4.66	6.59	6.66	6.53	7.65
Sept.	4.10	4.02	5.46	6.00	5.06	5.63	6.19	5.26	4.76	5.66	5.63	6.03	7.53	5.62	5.60	14.16	8.22	8.34	6.60	7.57	7.92	4.74	6.01	6.61	6.64	8.12
Oct.	4.10	4.20	5.46	6.06	5.17	6.06	6.16	5.46	4.61	6.09	5.69	6.20	7.57	5.62	4.97	13.96	9.66	8.24	6.11	7.63	7.61	5.10	7.20	6.66	6.67	8.65
Nov.	4.20	4.32	5.29	5.66	5.49	6.17	6.36	5.10	5.03	6.32	5.95	6.60	7.46	5.29	5.12	17.15	11.90	7.96	5.70	8.14	6.84	5.16	7.46	6.70	7.14	9.04
Dec.	4.19	4.35	4.91	5.15	5.90	6.50	6.02	4.39	5.17	6.35	5.90	6.44	7.33	5.16	5.71	16.69	11.13	7.84	6.45	8.59	6.00	5.25	7.46	6.63	7.73	8.97
Avg.	4.36	4.04	4.86	5.21	5.11	5.90	6.17	6.06	4.74	5.51	5.61	5.86	7.11	5.76	5.27	14.24	13.66	9.10	6.20	7.36	8.06	5.13	6.09	7.00	6.70	7.96

	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941*	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954
Jan.	8.75	7.03	6.00	6.70	5.59	4.37	3.38	3.38	4.62	4.06	5.22	6.20	5.35	4.86	6.03	7.65	8.65	11.005	11.00	10.16	9.40	18.22	20.29	13.43	10.26
Feb.	8.16	7.04	5.90	6.70	5.53	4.36	3.19	3.04	4.73	4.06	5.23	6.00	5.17	4.89	5.93	7.65	8.65	11.005	12.61	10.20	10.47	18.22	20.29	12.31	9.66
Mar.	7.90	7.06	5.96	6.80	5.30	4.30	3.16	3.37	4.72	4.25	5.27	7.75	4.77	4.99	6.14	7.65	8.66	11.005	12.61	17.76	10.66	18.22	20.29	11.86	10.16
Apr.	7.36	6.89	6.11	7.04	5.19	4.06	3.10	3.66	4.72	4.36	5.27	7.70	4.53	4.89	6.14	7.65	8.65	11.005	12.61	14.76	11.41	18.25	20.29	11.63	10.75
May	7.16	6.43	6.37	6.66	4.96	3.66	2.99	4.17	4.71	4.60	5.27	7.10	4.43	4.89	6.20	7.65	8.65	11.005	12.64	12.56	12.71	18.25	20.33	11.63	10.79
June	7.47	6.57	6.50	7.00	4.79	3.75	3.16	4.70	4.59	4.67	5.26	7.10	4.53	4.89	6.63	7.65	8.65	11.005	12.65	10.27	15.40	18.25	18.57	11.63	11.46
July	7.76	6.56	6.55	7.10	4.66	4.25	2.82	5.24	4.66	4.70	5.16	7.27	5.14	4.91	6.54	7.65	8.69	11.005	13.00	10.06	15.72	18.25	15.53	11.67	11.50
Aug.	7.69	6.70	6.69	7.15	4.72	4.17	3.13	5.25	4.63	4.92	5.17	7.56	5.14	5.11	6.79	7.65	8.69	11.005	15.66	10.70	15.72	18.26	14.98	11.53	11.50
Sept.	7.70	6.86	6.60	7.15	4.62	4.09	3.66	5.06	4.43	5.04	5.22	7.54	5.24	5.51	7.33	7.65	8.69	11.005	15.66	10.77	17.62	18.29	14.86	10.66	11.90
Oct.	7.66	6.38	6.60	7.00	4.40	3.73	3.41	5.12	4.19	5.21	5.22	6.45	5.40	6.66	7.65	8.36	9.20	11.00	15.74	10.04	18.22	20.22	14.66	10.50	12.06
Nov.	7.56	6.66	6.62	6.63	4.63	3.56	3.46	4.67	4.66	5.23	5.35	5.96	5.12	6.66	7.64	8.65	10.06	11.06	17.27	10.46	18.22	20.29	13.33	10.50	12.06
Dec.	7.36	6.15	6.70	6.66	4.43	3.50	3.50	4.92	4.66	5.22	5.64	5.36	4.99	6.46	7.65	8.65	10.94	11.06	18.15	10.47	18.22	20.29	13.33	10.50	12.06
Avg.	7.70	6.60	6.36	6.87	4.90	3.96	3.25	4.40	4.51	4.70	5.27	6.96	4.96	5.51	6.73	7.6	9.09	11.02	14.20	12.85	14.51	18.73	17.03	11.54	11.19

* 1942-1945 incl.: 8.65.

ALUMINUM INGOT Cents Per Pound, 99 Pct

Yearly Prices 1900-1919

Year	Average	Year	Average	Year	Average	Year	Average	Year	Average
1900	33.90	1904	33.00	1908	29.30	1912	20.50	1916	35.90
1901	33.90	1905	33.20	1909	24.00	1913	21.40	1917	37.90
1902	33.00	1906	30.40	1910	22.90	1914	19.40	1918	32.90
1903	33.00	1907	37.90	1911	20.40	1915	24.80	1919	33.00

Monthly Prices, 1920-1954

	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934
Jan.	$35.00	$26.50	$20.00	$25.00	$27.00	$28.00	$28.00	$28.45	$24.30	$24.30	$24.30	$23.30	$23.30	$23.30	$23.30
Feb.	35.00	26.50	20.00	25.54	27.00	28.00	28.00	26.00	24.30	24.30	24.30	23.30	23.30	23.30	23.30
Mar.	35.00	26.50	20.00	26.00	27.71	28.00	28.00	26.00	24.30	24.30	24.30	23.30	23.30	23.30	23.30
Apr.	35.00	26.50	20.00	26.00	26.00	28.00	28.00	26.00	24.30	24.30	24.30	23.30	23.30	23.30	23.30
May	35.00	26.50	20.00	26.00	26.00	28.00	28.00	26.00	24.30	24.30	24.30	23.30	23.30	23.30	23.30
June	35.00	26.50	20.00	26.00	26.00	28.00	28.00	26.00	24.30	24.30	24.13	23.30	23.30	23.30	23.30
July	35.00	26.50	20.00	26.00	26.00	26.00	27.00	26.00	24.30	24.30	23.30	23.30	23.30	23.30	21.67
Aug.	34.40	25.00	20.00	26.00	26.00	26.00	27.00	26.00	24.30	24.30	23.30	23.30	23.30	23.30	21.00
Sept	35.00	25.00	20.33	26.00	26.00	26.00	27.00	26.00	24.30	24.30	23.30	23.30	23.30	23.30	21.00
Oct.	33.00	25.00	22.00	26.00	26.00	27.66	27.00	25.61	24.30	24.30	23.30	23.30	23.30	23.30	21.00
Nov.	33.00	26.63	23.00	26.60	26.00	29.00	27.00	25.00	24.30	24.30	23.30	23.30	23.30	23.30	21.00
Dec.	31.26	20.00	25.00	27.00	26.00	29.00	27.00	24.75	24.30	24.30	23.30	23.30	23.30	23.30	21.00
Avg.	34.31	26.60	20.91	26.01	27.81	28.14	27.80	25.82	24.30	24.30	23.79	23.30	23.30	23.30	21.21

	1935	1936	1937	1938	1939	1940	1941*	1948	1949	1950	1951	1952	1953	1954
Jan.	$21.00	$19.00	$19.00	$20.00	$20.00	$20.00	$17.00	$15.00	$17.00	$17.00	$19.00	$19.00	$20.23	$21.50
Feb.	21.00	19.00	19.00	20.00	20.00	20.00	17.00	15.00	17.00	17.00	19.00	19.00	20.50	21.50
March	21.00	19.00	20.00	20.00	20.00	20.00	17.00	15.00	17.00	17.00	19.00	19.00	20.50	21.50
Apr.	19.00	19.00	20.00	20.00	20.00	19.00	17.00	15.00	17.00	17.00	19.00	19.00	20.50	21.50
May	19.00	19.00	20.00	20.00	20.00	19.00	17.00	15.00	17.00	17.20	19.00	19.00	20.50	21.50
June	19.00	19.00	20.00	20.00	20.00	19.00	17.00	15.00	17.00	17.50	19.00	19.00	20.50	21.50
July	19.00	19.00	20.00	20.00	20.00	19.00	17.00	15.00	17.00	17.50	19.00	19.00	20.94	21.50
Aug.	19.00	19.00	20.00	20.00	20.00	18.00	17.00	15.00	17.00	17.50	19.00	20.00	21.50	22.00
Sept.	18.00	19.00	20.00	20.00	20.00	18.00	17.00	15.00	17.00	17.69	19.00	20.00	21.50	22.20
Oct.	19.00	19.00	20.00	20.00	20.00	18.00	15.00	16.70	17.00	19.00	19.00	20.00	21.50	22.20
Nov.	19.00	19.00	20.00	20.00	20.00	17.50	15.00	17.00	17.00	19.00	19.00	20.00	21.50	22.20
Dec.	19.00	19.00	20.00	20.00	20.00	17.00	15.00	17.00	17.00	19.00	19.00	20.00	21.50	22.20
Avg.	19.50	19.00	19.83	20.00	20.00	18.71	16.50	15.68	17.00	17.70	19.00	19.42	20.83	21.78

* 1942-1947 incl.: $15.00.

F.o.b. mill: 1900 to July 14, 1921.

Freight allowed: July 15, 1921 to date.

Base: 1900 to June 25, 1930, 100,000 lb.
June 26, 1930 to July 8, 1934, no base quantity.
July 10, 1934 to Mar. 24, 1940, 30,000 lb.
Mar 25, 1940 to present, 10,000 lb.

Aluminum Co. of America



FIRST pot line for making aluminum in America at Smallman St. plant of The Pittsburgh Reduction Co. (now Alcoa). Output was 50 lb per day.

PIG IRON

U. S. pig iron production, 1810-1954. Prices: Basic Valley iron, foundry iron at Valley, Birmingham, Buffalo, Granite City and Chicago.

U. S. PRODUCTION OF PIG IRON AND FERROALLOYS Net Tons, 1810-1954

Years	Total Production	Blast Furnace Production		Electric Furnace Production
		Pig Iron	Ferro-Alloys	Ferro-Alloys
1954	59,008,242	57,965,548	721,338	1,119,356
1953	77,250,168	74,901,429	955,443	1,393,296
1952	63,383,955	61,312,936	837,985	1,233,029
1951	72,448,943	70,274,278	953,472	1,220,793
1950	66,490,311	64,588,907	852,082	980,542
1949	54,918,785	53,412,862	762,972	741,251
1948	61,911,859	60,065,216	988,590	857,753
1947	69,117,319	66,328,912	985,436	802,971
1946	48,199,826	44,778,796	769,111	651,919
1945	54,918,029	53,223,169	943,313	752,547
1944	62,986,196	61,007,439	1,065,244	793,515
1943	62,769,947	60,810,670	1,109,644	849,633
1942	60,903,304	59,075,944	1,039,443	787,917
1941	56,686,684	55,180,551	969,955	616,090
1940	47,398,529	46,071,686	907,425	419,438
1939	35,677,667	34,686,682	587,796	289,619
1938	21,469,164	20,771,588	410,971	277,595
1937	41,662,660	40,465,147	786,040	411,353
1936	34,752,669	33,942,533	633,637	275,519
1935	23,937,423	23,274,481	429,464	233,808
1934	16,075,202	17,556,116	369,673	147,413
1933	14,947,074	14,560,805	259,292	126,997
1932	9,835,227	9,575,624	177,653	81,950
1931	20,637,516	20,112,712	381,193	143,611
1930	35,862,429	34,743,418	594,457	224,556
1929	47,727,681	46,786,801	739,821	226,759
1928	42,734,400	41,889,845	642,476	202,078
1927	40,063,023	40,161,220	663,742	208,561
1926	44,097,457	43,342,227	861,949	193,281
1925	41,104,634	40,450,268	481,275	173,090
1924	35,174,465	34,579,737	427,064	167,664
1923	45,204,484	44,467,985	549,333	187,166
1922	30,466,292	30,044,067	267,026	154,599
1921	16,690,791	16,387,342	233,960	69,391
1920	41,367,186	40,993,157	585,764	178,184
1919	34,737,207	34,207,945	400,727	128,535
1918	43,741,301	42,673,001	632,166	236,034
1917	43,255,782	42,445,697	693,670	116,395
1916	44,166,673	43,414,256	696,530	57,152
1915	33,606,159	33,067,764	415,202	23,193
1914	26,132,113	25,758,088	374,025	
1913	34,662,090	34,292,349	369,741	Included
1912	33,294,169	32,910,482	383,687	with Blast
1911	26,467,493	26,179,806	287,687	Furnace
1910	30,379,995	30,183,295	196,700	Ferro-Alloys
1909	25,990,920	25,489,757	401,171	
1908	17,848,340	17,604,513	243,827	
1907	25,875,124	25,399,747	475,377	
1906	25,344,084	27,921,438	422,616	
1905	25,781,466	25,357,399	394,107	
1904	16,476,677	16,151,740	324,937	
1903	20,170,362	19,896,884	273,478	
1902	19,958,894	19,655,671	304,193	
1901	17,783,756	17,347,186	436,570	
1900	15,443,961	15,074,618	366,333	
1899	13,283,157	15,009,047	246,140	Sources:
1898	13,186,886	12,947,366	239,421	THE IRON AGE
1897	10,611,002	10,616,464	194,538	and
1896	9,657,902	9,510,129	147,773	American
1895	10,579,865	10,387,534	192,331	Iron and Steel
1894	7,456,275	7,321,673	134,602	Institute

Years	Total Production	Blast Furnace Production	
		Pig Iron	Ferro-Alloys
1893	7,979,442	7,888,590	90,852
1892	10,256,840	10,056,213	200,627
1891	9,273,484	9,130,356	143,098
1890	10,307,027	10,157,865	149,162
1889	8,516,079	8,430,256	85,823
1888	7,260,507	7,213,738	54,769
1887	7,187,206	7,139,608	47,598
1886	6,365,328	6,317,346	47,982
1885	4,529,989	4,495,188	34,671
1884	4,589,613	4,555,729	33,893
1883	5,146,972	5,122,398	24,574
1882	5,178,122	5,159,183	18,939
1881	4,641,564	4,620,478	21,086
1880	4,295,414	4,275,811	19,603
1879	3,070,875	3,056,944	13,931
1878	2,577,361	2,566,687	10,674
1877	2,314,585	2,305,740	8,845
1876	2,093,236	2,086,620	6,616
1875	2,295,581	2,288,749	7,832
1874	2,688,413	2,684,855	4,588
1873	2,868,278	2,863,876	4,402
1872	2,854,559	2,849,997	4,561
1871	1,912,608	1,912,608	.....
1870	1,865,000	1,865,000	.....
1869	1,916,641	1,916,641	.....
1868	1,603,000	1,603,000	.....
1867	1,461,626	1,461,626	.....
1866	1,350,343	1,350,343	.....
1865	931,582	931,582	.....
1864	1,135,996	1,135,996	.....
1863	947,604	947,604	.....
1862	787,662	787,662	.....
1861	731,544	731,544	.....
1860	919,770	919,770	.....
1859	840,627	840,627	.....
1858	705,094	705,094	.....
1857	798,157	798,157	.....
1856	883,137	883,137	.....
1855	794,178	794,178	.....
1854	736,218	736,218	.....
1853	901,666	901,666	.....
1852	685,645	685,645	.....
1851	462,560	462,560	.....
1850	631,406	631,406	.....
1849	728,000	728,000	.....
1848	896,000	896,000	.....
1847	896,000	896,000	.....
1846	856,000	856,000	.....
1845	562,240	562,240	.....
1844	844,328	844,328	.....
1842	240,000	240,000	.....
1840	321,331	321,331	.....
1839	263,200	263,200	.....
1837	280,000	280,000	.....
1832	224,000	224,000	.....
1831	213,928	213,928	.....
1830	184,000	184,048	.....
1829	159,040	159,040	.....
1828	145,000	145,000	.....
1820	22,400	22,400	.....
1810	80,377	80,377	.....

THE IRON AGE PIG IRON COMPOSITE PRICE

Dollars Per Gross Ton†

	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925
Jan.	$23.17	$13.50	$15.82	$22.06	$13.47	$15.95	$17.30	$23.24	$16.04	$15.66	$17.12	$13.63	$12.65	$16.49	$12.76	$12.33	$17.81	$26.68	$33.21	$31.33	$31.06	$31.18	$18.48	$26.78	$22.15	$22.44
Feb.	23.04	13.97	16.14	21.47	13.17	15.81	17.10	23.33	16.35	15.35	16.77	13.63	12.61	16.31	13.16	12.38	17.76	29.75	33.21	31.36	42.33	28.45	16.14	17.20	22.84	22.84
Mar.	22.96	13.12	16.93	21.54	13.43	15.96	17.10	23.02	15.97	15.03	16.29	13.86	12.93	16.67	13.16	12.34	18.06	32.18	33.21	33.10	42.17	25.18	15.35	33.11	22.81	21.90
Apr.	22.76	15.53	16.27	20.93	13.65	15.68	17.03	23.03	15.55	14.38	15.97	13.79	13.09	16.74	13.13	12.37	18.15	33.53	32.71	27.11	42.53	23.73	20.05	33.83	22.31	20.95
May	20.54	15.21	16.96	19.54	13.19	15.63	17.07	23.97	15.16	14.38	15.27	13.53	13.27	14.98	13.01	12.37	18.06	41.87	32.71	26.91	43.64	22.78	23.35	29.74	21.40	19.89
June	19.11	14.81	20.91	18.83	12.66	15.04	16.94	23.47	15.35	14.71	14.90	13.27	13.36	14.35	12.97	12.45	17.91	47.95	32.71	26.46	44.09	21.73	23.95	28.23	20.27	19.25
July	16.51	14.79	21.25	17.79	11.84	14.37	16.96	22.51	14.91	15.16	14.72	13.21	13.66	13.99	12.92	12.55	17.79	52.11	32.73	26.37	45.44	20.22	23.56	25.96	19.31	18.95
Aug.	16.17	14.68	21.70	16.98	12.07	14.64	17.48	21.82	15.06	15.52	14.39	13.12	14.15	13.93	12.91	13.55	17.53	51.43	32.73	26.53	47.38	18.97	26.69	25.19	19.43	19.02
Sept.	13.87	14.43	22.27	16.03	12.07	14.94	18.59	20.85	15.03	16.41	14.17	12.99	14.74	13.97	12.83	14.28	17.62	46.93	32.73	27.11	47.63	19.80	21.78	25.02	19.46	19.36
Oct.	13.24	14.84	22.35	15.02	12.67	15.61	19.52	19.98	14.79	17.25	13.79	12.84	16.01	13.93	12.67	14.67	19.16	33.21	31.31	27.52	45.06	19.97	20.57	23.30	19.46	19.91
Nov.	13.57	14.98	22.54	14.23	14.37	17.01	22.17	18.66	15.21	17.46	13.74	12.71	16.81	13.39	12.42	15.62	24.38	33.21	34.36	30.34	39.65	18.79	27.62	21.40	19.79	21.19
Dec.	13.68	15.34	22.33	13.75	15.77	17.10	22.62	17.52	15.73	17.28	13.76	12.59	16.63	13.06	12.39	17.34	29.63	33.21	34.26	30.13	34.51	19.11	25.70	21.88	21.60	21.59
Avg.	18.14	14.79	20.04	18.18	13.20	15.65	18.36	21.75	15.49	15.72	15.06	13.28	14.14	14.68	12.87	13.54	19.43	36.11	33.24	28.97	42.76	22.59	24.06	28.30	20.90	20.56

	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941*	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954
Jan.	$21.79	$18.44	$17.63	$18.43	$18.19	$15.90	$14.68	$13.56	$16.90	$17.90	$18.84	$20.25	$23.25	$20.61	$22.61	$23.45	$23.61	$25.37	$30.14	$39.83	$46.79	$45.96	$52.00	$52.72	$55.26	$56.50
Feb.	21.77	19.07	17.73	18.38	18.02	15.82	14.61	13.56	16.90	17.90	18.84	20.50	23.25	20.61	22.61	23.45	24.11	25.37	30.15	40.27	46.74	46.38	52.00	52.72	55.26	56.50
Mar.	21.85	19.03	17.73	18.35	17.75	15.71	14.45	13.56	16.90	17.90	18.84	22.85	23.25	20.61	22.61	23.53	24.61	25.75	32.92	40.32	46.74	46.38	52.00	52.72	55.26	56.50
Apr.	20.96	19.21	17.67	18.52	17.73	15.79	14.35	13.76	17.07	17.90	18.84	23.25	23.25	20.61	22.61	23.61	24.61	26.12	33.15	40.11	46.64	46.38	52.00	52.72	55.26	56.50
May	20.69	19.09	17.45	18.70	17.60	15.76	14.12	14.48	17.90	17.84	18.84	23.25	23.25	20.61	22.61	23.61	24.61	26.45	33.15	40.33	45.97	46.38	52.00	52.77	55.26	56.50
June	20.00	18.92	17.23	18.65	17.48	15.62	14.01	15.01	17.90	17.84	18.84	23.25	22.96	20.61	22.61	23.61	24.61	25.13	33.15	40.51	45.91	46.38	52.00	52.77	55.32	56.50
July	19.51	18.56	17.10	18.48	17.16	15.56	13.76	15.50	17.90	17.84	18.84	23.25	19.61	20.61	22.61	23.61	24.61	26.13	34.52	42.75	45.91	46.38	52.00	53.27	56.73	56.50
Aug.	19.46	18.17	17.11	18.39	16.90	15.51	13.69	16.09	17.90	17.84	18.73	23.25	19.61	20.61	22.61	23.61	24.61	26.13	33.84	44.34	45.91	46.56	52.00	55.26	56.76	56.50
Sept.	19.46	18.03	17.54	18.27	16.70	15.44	13.64	16.71	17.90	17.84	18.73	23.25	19.82	21.61	22.61	23.61	24.61	26.13	36.95	44.96	45.90	47.16	52.00	55.26	56.66	56.50
Oct.	19.69	17.96	17.94	18.33	16.31	15.21	13.63	16.61	17.90	17.87	18.73	23.25	20.57	22.61	22.61	23.61	24.61	26.13	36.95	46.63	45.86	49.29	52.72	55.26	56.59	56.50
Nov.	20.13	17.59	18.46	18.36	16.21	14.97	13.59	16.61	17.90	18.84	18.86	23.25	20.61	22.61	22.61	23.61	25.37	26.13	37.04	46.84	45.86	49.69	52.72	55.26	56.59	56.50
Dec.	19.94	17.55	18.51	18.24	15.95	14.86	13.56	16.90	17.90	18.84	19.73	23.25	20.61	22.61	22.95	23.61	25.37	29.64	37.24	46.81	45.86	52.50	52.72	55.26	56.59	56.50
Avg.	20.42	18.55	17.68	18.43	17.17	15.51	14.00	15.20	17.56	18.03	18.90	22.74	21.67	21.19	22.64	23.56	24.81	27.29	34.35	42.94	46.16	47.83	52.70	53.83	55.96	56.49

* Price unchanged at $23.61 from 1942 through 1944.

† Average of THE IRON AGE quotations on basic pig iron at Valley furnaces and foundry iron at Chicago, Birmingham, Buffalo, Valley and Philadelphia, in gross tons.

VALLEY BASIC PIG IRON Per Gross Ton, at Mahoning, Shenango Furnaces

	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926
Jan.	.....	$15.46	$17.06	$21.90	$16.90	$15.50	$16.87	$13.25	$12.35	$16.41	$12.50	$12.50	$17.81	$30.00	$33.00	$30.00	$37.40	$30.00	$18.16	$25.80	$21.25	$22.00	$20.00
Feb.	.....	15.25	16.82	22.00	15.97	15.12	16.31	13.65	12.25	16.30	13.19	12.50	17.69	30.00	33.00	30.00	42.25	27.50	17.75	26.25	22.00	22.00	20.00
Mar.	.....	15.55	16.85	21.50	15.62	14.94	16.00	13.75	12.81	16.11	13.00	12.50	18.20	32.25	33.00	28.94	41.50	24.20	17.94	30.13	21.94	21.30	20.00
Apr.	.....	15.06	16.88	21.50	15.25	14.05	15.94	13.75	13.00	16.87	13.00	12.50	18.13	38.75	32.00	25.75	42.40	22.88	20.00	31.05	21.85	20.13	18.63
May	.....	15.06	17.00	22.00	14.91	14.12	15.19	13.32	13.00	16.15	13.00	12.50	18.00	41.60	32.00	25.75	43.25	22.00	24.60	29.00	20.50	18.91	18.38
June	$11.76	14.60	16.94	22.40	15.25	14.62	14.70	13.05	13.12	14.80	13.00	12.69	18.00	48.75	32.00	25.75	44.00	20.75	25.00	27.38	19.63	18.05	18.00
July	11.20	14.00	17.12	21.75	14.51	15.06	14.60	13.12	13.40	14.37	13.00	12.74	18.00	52.50	32.00	25.75	45.85	19.38	24.25	25.16	19.00	18.00	17.63
Aug.	11.69	14.32	17.70	21.25	14.69	15.25	14.12	13.00	13.94	14.06	13.00	14.06	18.00	51.20	32.00	25.75	46.10	18.20	26.60	24.75	19.00	18.00	17.50
Sept.	11.60	14.86	18.44	20.06	14.43	15.90	13.70	12.90	14.37	14.00	13.00	14.75	18.31	42.75	32.00	25.75	46.50	19.13	32.63	24.88	19.00	18.30	17.60
Oct.	12.19	15.25	19.55	19.50	14.04	16.94	13.15	12.52	15.98	13.90	12.81	15.00	19.88	33.00	33.00	25.75	43.75	19.19	30.90	23.50	19.00	18.63	18.00
Nov.	14.00	16.87	21.37	18.12	14.72	17.25	13.25	12.42	16.37	13.09	12.48	16.75	25.10	33.00	33.00	28.31	36.50	19.00	27.75	20.88	19.13	19.88	18.50
Dec.	15.70	16.75	21.50	17.50	15.60	17.05	13.40	12.25	16.50	12.71	12.50	17.50	30.00	33.00	33.00	34.28	33.00	18.63	24.81	21.00	20.90	20.00	18.50
Avg.	12.89	15.25	18.10	20.87	15.16	15.48	14.76	13.07	13.92	14.71	12.87	13.74	19.76	38.96	32.50	27.66	42.21	21.74	24.20	25.81	20.24	19.59	18.55

	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940*	1945	1946	1947	1948**	1950	1951	1952	1953	1954
Jan.	$18.00	$17.00	$17.50	$18.50	$17.00	$15.00	$13.80	$17.00	$18.00	$19.00	$20.50	$23.50	$20.50	$22.50	$23.50	$25.25	$30.00	$38.67	$46.00	$52.00	$52.00	$54.50	$56.00
Feb.	18.00	17.00	17.50	18.50	16.75	14.62	13.50	17.00	18.00	19.00	20.75	23.50	20.50	22.50	24.00	25.25	30.00	39.00	46.00	52.00	52.00	54.50	56.00
Mar.	18.40	17.00	17.50	18.50	16.50	14.50	13.50	17.00	18.00	19.00	23.10	23.50	20.50	22.50	24.50	25.63	33.00	39.00	46.00	52.00	52.00	54.50	56.00
Apr.	19.00	16.88	17.90	18.50	16.50	14.50	13.50	17.25	18.00	19.00	23.50	23.50	20.50	22.50	24.50	26.00	33.00	39.00	46.00	52.00	52.00	54.50	56.00
May	18.20	16.30	18.38	18.50	16.25	14.20	14.20	18.00	18.00	19.00	23.50	23.50	20.50	22.50	24.50	26.00	33.00	39.00	46.00	52.00	52.00	54.50	56.00
June	17.88	15.45	18.50	18.50	15.50	14.00	15.00	18.00	18.00	19.00	23.50	22.70	20.50	22.50	24.50	28.00	33.00	39.00	46.00	52.00	52.00	54.50	56.00
July	17.50	16.00	18.50	18.10	15.50	13.50	15.50	18.00	18.00	19.00	23.50	19.50	20.50	22.50	24.50	28.00	34.20	42.00	46.00	52.00	52.00	56.00	56.00
Aug.	17.30	16.00	18.50	18.00	15.50	13.50	16.20	18.00	18.00	19.00	23.50	19.50	20.50	22.50	24.50	28.00	36.00	43.00	46.00	52.00	54.50	56.00	56.00
Sept.	17.06	16.19	18.50	17.60	15.50	13.50	17.00	18.00	18.00	19.00	23.50	19.75	21.50	22.50	24.50	28.00	36.00	43.00	46.75	52.00	54.50	56.00	56.00
Oct.	17.00	17.10	18.50	17.00	15.25	13.50	17.00	18.00	18.00	19.00	23.50	20.50	22.50	22.50	24.00	28.00	36.00	45.62	49.00	52.00	54.50	56.00	56.00
Nov.	17.00	17.50	18.50	17.00	15.00	13.50	17.00	18.00	19.00	19.25	23.50	20.50	22.50	22.50	25.25	28.00	36.00	46.00	49.00	52.00	54.50	56.00	56.00
Dec.	17.00	17.50	18.50	17.00	15.00	13.50	17.00	18.00	19.00	20.00	23.50	20.50	22.50	22.90	25.25	29.60	36.20	46.00	51.62	52.00	54.50	56.00	56.00
Avg.	17.69	16.66	18.19	17.97	15.85	13.98	15.24	17.99	18.17	19.10	22.99	21.70	21.09	22.53	24.82	27.14	34.78	41.62	47.03	52.00	53.08	55.25	56.00

* Price unchanged at $22.50 from 1941 through 1944.

** Price unchanged at $46.00 through 1949.

VALLEY FOUNDRY PIG IRON Per Gross Ton, at Mahoning, Shenango Valley Furnaces

	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924
Jan.	$21.50	$13.20	$15.00	$22.30	$13.00	$16.12	$17.31	$24.60	$16.80	$15.44	$17.00	$13.75	$13.00	$17.80	$12.85	$13.00	$18.00	$31.00	$33.00	$31.00	$39.40	$31.88	$19.30	$27.00	$22.50
Feb.	22.04	13.16	16.20	21.95	12.47	16.00	17.25	24.12	16.00	15.06	16.69	13.75	13.00	17.00	13.10	13.00	18.31	32.00	33.00	31.00	41.50	29.00	18.88	27.50	23.00
Mar.	22.10	13.97	17.76	22.00	12.91	16.00	17.12	24.00	16.56	14.80	16.10	13.75	13.12	16.69	13.25	13.00	18.50	34.75	33.00	29.84	41.25	25.90	19.00	30.50	23.00
Apr.	21.25	14.10	19.30	20.99	13.01	15.00	16.50	24.00	15.15	14.00	15.62	13.75	13.25	15.55	13.25	12.75	18.50	30.75	33.00	26.75	42.50	24.75	20.75	31.00	21.80
May	20.30	14.10	19.92	20.32	12.47	15.55	16.30	25.00	14.87	14.19	15.21	13.75	13.25	14.62	13.00	12.94	18.20	42.40	33.00	26.75	44.25	23.50	22.50	30.20	20.75
June	17.91	13.84	20.60	19.37	11.96	14.61	16.19	25.12	15.00	14.90	14.75	13.56	13.25	14.06	13.00	12.89	18.13	50.25	33.00	26.75	45.00	22.10	24.00	27.63	19.83
July	16.29	13.20	21.10	18.02	11.67	14.25	16.44	22.00	14.80	15.19	14.31	13.50	13.37	13.87	13.00	12.70	18.25	54.50	33.00	26.75	45.00	20.13	24.25	25.50	19.00
Aug.	14.42	12.87	22.26	16.34	11.87	14.15	17.71	22.50	14.50	15.31	14.15	13.50	13.69	14.00	13.00	13.62	18.25	53.20	33.00	26.75	47.00	18.63	32.60	24.68	19.13
Sept.	13.16	13.10	22.30	14.86	11.71	14.56	19.56	20.87	14.47	15.75	13.75	13.44	14.44	14.00	13.00	14.70	18.38	47.00	33.00	26.75	49.40	21.00	34.85	24.75	19.80
Oct.	12.55	13.60	22.17	14.00	12.50	15.50	21.35	19.60	14.36	17.12	13.94	13.37	16.10	13.84	12.90	14.87	20.00	33.00	34.00	26.75	46.50	21.00	31.80	23.60	19.50
Nov.	12.33	14.41	23.25	13.32	14.60	16.83	23.87	19.00	15.25	17.25	13.90	13.20	16.94	13.50	12.75	15.50	25.00	33.00	34.00	31.80	46.25	20.75	27.88	21.88	19.50
Dec.	13.04	15.20	21.25	13.22	16.16	17.36	24.00	17.37	15.50	17.00	13.75	13.00	17.25	13.50	12.75	16.30	30.75	33.00	34.00	30.75	46.20	20.00	25.63	22.00	21.20
Avg.	17.35	13.72	20.10	18.06	12.86	15.99	18.63	22.43	15.10	15.48	14.84	13.63	14.22	14.84	13.00	13.92	20.07	40.32	33.25	28.95	43.21	23.22	26.23	26.37	20.73

	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940*	1945	1946	1947	1948**	1950	1951	1952	1953	1954
Jan.	$22.50	$20.50	$18.50	$17.25	$17.50	$18.50	$17.00	$15.50	$14.50	$17.50	$18.50	$19.50	$21.00	$24.00	$21.00	$23.00	$24.00	$25.75	$30.50	$30.37	$46.50	$52.50	$52.50	$55.00	$50.50
Feb.	22.00	20.50	18.50	17.25	17.50	18.50	16.75	15.12	14.50	17.50	18.50	19.50	21.25	24.00	21.00	23.00	24.50	25.75	30.50	30.50	46.50	52.50	52.50	55.00	50.50
Mar.	21.10	20.50	18.50	17.25	17.75	18.50	16.50	15.00	14.50	17.50	18.50	19.50	23.00	24.00	21.00	23.00	25.00	26.13	33.50	30.50	46.50	52.50	52.50	55.00	50.50
Apr.	20.13	19.00	18.50	17.25	18.00	18.50	17.00	15.00	14.50	17.75	18.50	19.50	24.00	24.00	21.00	23.00	25.00	26.50	33.50	30.50	46.50	52.50	52.50	55.00	50.00
May	19.13	18.88	18.50	17.20	18.50	18.50	17.00	14.70	14.70	18.50	18.50	19.50	24.00	24.00	21.00	23.00	25.00	26.50	33.50	30.50	46.50	52.50	52.50	55.00	50.50
June	18.30	17.96	18.13	16.75	18.50	18.50	17.00	14.50	14.50	18.50	18.50	19.50	24.00	23.20	21.00	23.00	25.00	26.50	33.50	30.50	46.50	52.50	52.50	55.00	50.50
July	18.50	17.69	18.00	16.65	18.50	18.50	17.00	14.50	16.00	18.50	18.50	19.50	24.00	20.00	21.00	23.00	25.00	26.50	34.70	42.50	46.50	52.50	53.00	56.50	50.50
Aug.	18.50	17.50	17.50	16.50	18.50	18.50	17.00	14.50	16.70	18.50	18.50	19.50	24.00	20.00	21.00	23.00	25.00	26.50	36.50	43.00	46.50	52.50	55.00	56.50	50.50
Sept.	18.50	17.43	17.50	16.88	18.50	17.50	17.00	14.50	17.50	18.50	18.50	19.50	24.00	20.25	22.00	23.00	25.00	26.50	36.50	43.50	47.50	52.50	55.00	56.50	50.50
Oct.	19.13	18.50	17.50	17.10	18.50	17.13	16.83	14.50	17.50	18.50	18.50	19.50	24.00	21.00	23.00	23.00	25.30	26.50	36.50	46.12	49.50	52.50	55.00	56.50	50.50
Nov.	20.38	19.50	17.45	17.63	18.50	17.00	16.00	14.50	17.50	18.50	18.50	19.50	24.00	21.00	23.00	23.00	25.75	26.50	36.50	46.50	49.50	52.50	55.00	56.50	50.50
Dec.	20.50	18.88	17.25	17.70	18.50	17.00	15.70	14.50	17.50	18.50	19.50	20.50	24.00	21.00	23.00	23.40	25.75	30.10	36.70	46.50	52.12	52.50	55.00	56.50	50.50
Avg.	9.91	18.87	17.99	17.12	18.23	18.08	16.72	14.74	15.91	18.19	18.56	19.56	23.49	22.20	21.99	23.03	25.02	27.64	34.36	42.12	47.55	52.50	53.75	55.75	50.50

*Price unchanged at $24.00 from 1941 through 1944.
**Price unchanged at $46.50 through 1s48.

BIRMINGHAM FOUNDRY PIG IRON Per Gross Ton

	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926
Jan.	$11.00	$20.00	$ 9.04	$13.04	$14.50	$23.10	$13.65	$13.00	$14.13	$11.00	$10.00	$13.56	$10.63	$ 9.50	$15.00	$23.20	$33.00	$31.00	$38.75	$32.25	$16.20	$23.25	$21.50	$20.00	$22.00
Feb.	12.00	18.00	9.00	13.04	14.25	22.25	13.50	13.00	14.00	11.00	10.00	13.30	10.56	9.50	15.00	24.63	33.00	31.00	40.00	28.13	15.00	24.38	22.50	20.00	22.00
Mar.	12.13	18.38	9.56	13.06	14.37	22.50	13.00	12.50	13.42	11.00	10.25	13.06	10.70	9.38	15.00	29.00	33.00	29.44	40.00	25.30	15.00	26.40	22.50	20.00	22.00
Apr.	14.75	17.00	10.00	13.56	14.00	22.50	12.15	11.40	12.75	11.00	10.56	12.40	10.50	9.44	15.00	34.50	33.00	28.75	40.50	23.50	15.88	27.00	22.30	20.00	22.00
May	16.94	16.44	9.75	13.19	14.00	22.70	11.83	11.38	12.00	10.70	10.94	11.69	10.50	9.44	15.00	39.00	33.00	26.75	42.00	22.20	17.00	28.85	21.50	20.00	22.00
June	16.00	14.75	9.35	12.70	13.81	22.50	12.00	11.50	12.00	10.19	11.00	10.81	10.35	9.65	14.50	42.25	33.00	25.25	42.00	21.88	18.38	25.75	20.00	19.00	21.20
July	16.80	13.70	9.50	11.63	13.56	21.19	11.90	12.48	12.00	10.00	11.45	10.50	10.00	9.75	14.00	47.00	33.00	25.15	42.00	20.25	18.25	25.00	18.00	18.00	21.00
Aug.	21.25	12.75	9.50	12.00	14.55	20.40	12.38	13.25	11.50	10.20	11.51	10.81	10.00	10.75	13.00	47.00	33.00	27.38	42.00	18.00	20.10	23.70	17.50	18.00	21.00
Sept.	23.00	12.00	9.50	12.00	15.63	18.50	13.19	14.00	11.50	10.06	12.75	11.00	10.00	11.50	14.38	47.00	33.00	27.95	42.00	19.00	20.00	22.75	17.50	18.50	20.75
Oct.	23.40	11.88	10.50	13.00	16.87	18.00	13.00	15.00	11.50	10.00	13.50	11.25	10.00	12.13	15.50	33.00	34.00	28.00	42.00	19.00	20.80	20.63	17.50	19.38	20.00
Nov.	23.00	9.69	12.50	14.25	20.90	18.00	13.00	15.00	11.00	9.94	14.00	10.63	10.00	13.40	20.13	33.00	34.00	30.75	38.00	18.40	23.90	19.60	17.75	21.00	20.00
Dec.	22.38	9.50	13.00	14.50	22.56	15.00	13.00	14.40	11.00	9.94	14.00	10.70	9.00	14.38	23.00	33.00	33.40	35.20	36.00	17.33	22.88	21.00	19.50	22.00	20.00
Avg.	18.10	14.81	10.32	13.21	16.67	20.50	12.70	13.07	12.23	10.42	11.69	11.65	10.24	10.73	15.66	36.05	33.20	28.72	40.60	22.19	19.63	23.66	19.86	19.71	21.16

	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936†	1937	1938	1939*	1941‡	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954
Jan.	$18.50	$18.00	$16.50	$14.50	$13.00	$11.50	$11.00	$13.50	$14.50	$15.50	$17.38	$20.38	$17.38	$19.38	$20.38	$22.13	$22.13	$37.38	$43.38	$38.38	$48.88	$48.88	$51.38	$52.88
Feb.	18.00	18.00	16.50	14.63	12.88	11.00	11.00	13.50	14.50	15.50	17.63	20.38	17.38	19.38	20.88	22.13	26.88	37.38	43.38	42.38	48.88	48.88	51.38	52.88
Mar.	18.00	18.00	16.00	14.50	12.38	11.00	11.00	13.00	14.50	15.50	19.00	20.38	17.38	19.89	21.38	22.51	29.13	37.38	43.38	42.38	48.88	48.88	51.38	52.88
Apr.	18.00	18.00	15.40	14.00	12.00	11.00	11.25	13.50	14.00	15.50	20.38	20.38	17.38	20.38	21.38	22.88	29.88	37.38	43.38	42.38	48.88	48.88	51.38	52.88
May	18.00	15.70	15.00	14.00	12.00	11.00	12.00	14.38	14.50	15.50	20.38	20.38	17.38	20.38	21.38	22.88	29.88	38.38	39.71	42.38	48.88	48.88	51.38	52.88
June	18.00	15.00	15.00	14.00	12.00	11.00	12.00	14.50	14.50	15.50	20.38	19.56	17.38	20.38	21.38	24.00	29.88	38.38	38.38	42.38	48.88	48.88	51.38	52.88
July	17.44	15.00	14.38	14.00	12.00	11.00	12.00	14.50	14.50	15.50	20.38	16.38	17.38	20.38	21.38	24.88	31.26	31.04	39.38	42.38	48.88	48.88	52.88	52.88
Aug.	17.25	15.00	13.88	14.00	12.00	11.00	13.10	14.50	14.50	15.00	20.38	16.38	17.38	20.38	21.38	24.88	34.13	43.38	39.38	42.38	48.88	51.38	52.88	52.88
Sept.	17.25	16.25	13.88	14.00	12.00	11.00	12.50	14.00	14.00	15.00	20.38	16.63	16.38	20.38	21.38	24.88	34.88	43.38	39.38	42.07	48.88	51.38	52.88	52.88
Oct.	17.25	16.25	13.70	14.00	12.00	11.00	12.50	14.50	14.50	15.00	20.38	17.38	16.38	20.38	21.88	24.88	34.88	43.38	39.38	45.88	48.88	51.38	52.88	52.88
Nov.	16.00	16.38	14.00	14.00	12.00	11.00	13.50	14.50	14.75	15.13	20.38	17.38	16.38	20.38	22.13	24.88	34.88	43.38	39.38	48.88	48.88	51.38	52.88	52.88
Dec.	16.00	16.00	14.00	14.00	12.00	11.00	13.50	14.50	15.50	15.88	20.38	17.38	16.38	20.38	22.13	26.88	34.88	43.38	39.38	48.88	48.88	51.38	52.88	52.88
Avg.	17.47	16.01	14.82	14.14	12.26	11.04	12.32	14.15	14.60	15.70	19.87	18.58	17.06	20.17	21.46	24.06	31.43	40.43	40.74	43.53	48.88	49.96	52.13	52.88

* Price unchanged at $19.38 through 1940.
‡ Price unchanged at $20.38 from 1942 through 1944.
† Commencing August 1936, deduct 38¢ per ton for 0.70 phos and over.

BUFFALO FOUNDRY PIG IRON Per Gross Ton

	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930
Jan.	$16.94	$14.00	$13.50	$17.43	$12.85	$12.69	$18.75	$34.94	$33.00	$31.40	$40.90	$32.38	$19.44	$26.94	$22.25	$23.00	$21.00	$18.00	$18.45	$18.00	$18.75
Feb.	17.00	13.69	13.50	17.06	12.94	13.00	18.53	35.25	33.00	31.40	42.00	30.50	18.87	27.56	22.25	22.75	21.00	17.38	18.80	18.38	18.50
Mar.	16.95	14.06	13.63	16.79	13.22	12.41	18.72	38.45	33.00	30.56	44.75	29.00	18.30	29.05	21.81	22.12	21.00	17.00	18.39	18.50	18.50
Apr.	16.31	13.75	13.56	16.22	13.50	12.50	18.88	42.62	33.00	27.15	45.00	26.15	20.81	29.56	21.37	20.65	21.00	17.50	18.00	18.50	18.50
May	15.69	13.69	13.50	15.18	13.41	12.88	18.78	44.94	33.00	27.15	45.00	25.62	22.62	29.40	20.25	19.60	20.75	17.50	18.00	18.50	18.50
June	15.25	13.39	13.88	14.32	13.13	12.87	18.65	46.31	33.00	27.15	44.75	23.42	23.05	29.06	19.37	19.00	19.68	17.39	18.00	18.75	18.50
July	14.88	13.25	14.03	13.83	13.06	12.70	18.70	52.25	33.00	27.15	45.00	23.87	24.50	26.00	19.10	18.85	19.00	16.88	18.00	19.50	18.50
Aug.	14.25	13.50	14.50	13.98	13.25	13.85	18.63	53.00	33.00	27.40	47.75	19.50	30.70	24.95	19.19	18.72	19.00	16.10	18.13	19.50	18.50
Sept.	14.25	13.69	15.50	14.09	13.22	14.90	18.00	53.00	33.00	27.65	50.10	20.00	33.94	24.87	19.37	18.75	19.00	16.13	18.63	19.50	18.50
Oct.	14.19	13.10	16.62	14.00	12.72	15.63	20.37	53.00	34.00	28.15	47.44	20.37	31.12	23.06	19.05	18.40	19.00	16.88	17.10	19.50	17.75
Nov.	14.30	13.06	17.25	13.69	12.44	16.28	27.25	53.00	34.00	31.80	42.56	19.12	27.80	20.67	20.50	21.19	19.00	17.00	17.81	19.50	17.50
Dec.	14.50	13.25	17.56	12.87	12.95	18.13	32.75	53.00	34.00	36.90	36.60	19.30	26.50	21.56	22.62	21.56	19.06	17.00	17.69	19.50	17.50
Avg.	15.39	13.54	14.75	14.95	13.06	14.03	20.75	41.81	33.25	29.67	44.32	23.85	24.72	26.07	20.58	20.41	19.66	17.06	18.55	18.97	18.29

	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940*	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954
Jan.	$17.50	$16.00	$16.00	$17.50	$18.50	$19.50	$21.08	$24.00	$21.00	$23.00	$24.00	$25.75	$30.50	$40.37	$47.26	$46.50	$52.50	$52.50	$55.00	$56.50
Feb.	17.50	16.00	16.00	17.50	18.50	19.50	21.25	24.00	21.00	23.00	24.50	25.75	30.50	42.12	47.00	46.50	52.50	52.50	55.00	56.50
Mar.	17.50	16.00	16.00	17.50	18.50	19.50	23.00	24.00	21.00	23.00	25.00	26.13	32.38	42.45	47.00	46.50	52.50	52.50	55.00	56.50
Apr.	17.50	16.00	16.00	17.50	18.50	19.50	24.00	24.00	21.00	23.00	25.00	26.50	33.00	41.19	46.75	46.50	52.50	52.50	55.00	56.50
May	17.13	16.00	16.00	18.00	18.50	19.50	24.00	24.00	21.00	23.00	25.00	26.50	33.00	41.37	46.50	46.50	52.50	52.50	55.00	56.50
June	17.00	16.00	16.00	18.50	18.50	19.50	24.00	23.20	21.00	23.00	25.00	26.50	33.00	41.44	46.50	46.50	52.50	52.50	55.00	56.50
July	17.00	16.00	16.50	18.50	18.50	19.50	24.00	20.00	21.00	23.00	25.00	26.50	34.20	42.00	46.50	46.50	52.50	53.00	56.50	56.50
Aug.	17.00	16.00	17.10	18.50	18.50	19.50	24.00	20.00	21.00	23.00	25.00	26.50	37.37	44.90	46.50	46.50	52.50	55.00	56.50	56.50
Sept.	17.00	16.00	17.50	18.50	18.50	19.50	24.00	20.13	22.00	23.00	25.00	26.50	37.18	45.87	46.50	47.25	52.50	55.00	56.50	56.50
Oct.	17.00	16.00	17.50	18.50	18.50	19.50	24.00	20.68	23.00	23.00	25.38	26.50	37.00	47.12	46.50	49.50	52.50	55.00	56.50	56.50
Nov.	17.00	16.00	17.50	18.50	19.50	19.75	24.00	21.00	23.00	23.00	25.75	26.50	37.75	47.50	46.50	49.50	52.50	55.00	56.50	56.50
Dec.	16.50	16.00	17.50	18.50	19.50	20.50	24.00	21.00	23.00	23.40	25.75	30.10	38.00	47.50	46.50	52.50	52.50	55.00	56.50	56.50
Avg.	17.18	16.00	16.63	18.17	18.67	19.60	23.49	22.18	21.59	23.03	25.02	27.64	34.49	43.65	46.67	47.56	52.50	53.75	55.75	56.50

* Price unchanged at $24.00 from 1941 through 1944.

Bettmann Archive



BLOWERS providing a high-powered blast aided the development of commercial cupolas in the 1870's. Plant view shows manufacture of Roots rotary-type blowers.

GRANITE CITY FOUNDRY PIG IRON Per Gross Ton

	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936
Jan.	$31.61	$25.00	$25.00	$24.50	$22.31	$20.75	$20.75	$20.50	$16.25	$18.33	$18.33	$17.50	$18.50	$19.50
Feb.	31.61	26.00	26.00	24.50	22.00	20.75	20.75	20.00	18.25	18.33	18.33	17.50	18.50	19.50
Mar.	33.43	26.50	26.00	24.50	21.00	20.75	20.75	20.44	18.25	18.33	18.33	17.00	18.50	19.50
Apr.	34.31	26.00	24.37	24.00	21.50	20.75	20.75	20.25	18.25	18.33	17.34	17.75	18.50	19.00
May	34.31	24.31	22.50	23.00	21.50	20.75	20.75	19.75	18.25	18.33	16.55	18.00	18.50	19.50
June	33.00	23.00	21.50	23.16	21.31	20.75	20.75	19.75	18.25	18.33	16.85	18.50	18.50	19.50
July	30.16	22.01	21.50	23.00	21.00	20.75	20.75	19.10	18.25	18.33	17.35	18.50	18.50	19.50
Aug.	29.00	22.12	21.81	23.00	20.50	20.00	20.00	19.00	18.25	18.33	17.85	18.50	18.50	19.50
Sept.	29.31	22.40	23.50	23.00	20.50	20.50	20.50	18.70	18.25	18.33	17.50	18.50	18.50	19.50
Oct.	27.21	22.50	23.62	22.50	20.50	20.50	20.50	18.25	18.25	18.33	17.50	18.00	18.70	19.50
Nov.	25.93	22.50	24.12	22.36	20.50	20.50	20.50	18.25	18.25	18.33	17.50	18.00	19.50	19.50
Dec.	26.61	24.20	24.50	22.00	20.50	20.50	20.50	18.25	18.25	18.33	17.50	18.50	19.50	20.50
Avg.	30.61	24.11	23.09	23.42	21.21	20.66	20.66	19.39	18.25	18.33	17.58	18.19	18.68	19.56

	1937	1938	1939	1940*	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954
Jan.	$21.00	$24.00	$21.00	$23.00	$24.00	$25.75	$30.50	$39.25	$48.40	$48.40	$54.40	$54.40	$56.90	$58.40
Feb.	21.25	24.00	21.00	23.00	24.50	25.75	30.50	40.00	48.40	48.40	54.40	54.40	56.90	58.40
Mar.	23.60	24.00	21.00	23.00	25.00	26.13	32.00	40.00	48.40	48.40	54.40	54.40	56.90	58.40
Apr.	24.00	24.00	21.00	23.00	25.00	26.50	33.50	40.00	48.40	48.40	54.40	54.40	56.90	58.40
May	24.00	24.00	21.00	23.00	25.00	26.50	33.50	41.43	48.40	48.40	54.40	54.40	56.90	58.40
June	24.00	23.00	21.00	23.00	25.00	26.50	33.50	45.75	48.40	48.40	54.40	54.40	56.90	58.40
July	24.00	20.00	21.00	23.00	25.00	26.50	34.60	45.75	48.40	48.40	54.40	54.40	56.40	58.40
Aug.	24.00	20.00	21.00	23.00	25.00	26.50	36.63	47.34	48.40	48.40	54.40	56.90	58.40	58.40
Sept.	24.00	20.25	22.00	23.00	25.00	26.50	37.00	48.40	48.40	48.40	54.40	56.90	58.40	58.40
Oct.	24.00	21.00	23.00	23.00	25.30	26.50	37.00	48.40	48.40	51.40	54.40	56.90	58.40	58.40
Nov.	24.00	21.00	23.00	23.00	25.75	26.50	37.00	48.40	48.40	51.40	54.40	56.90	58.40	58.40
Dec.	24.00	21.00	23.00	23.00	25.75	29.70	37.00	48.40	48.40	53.85	54.40	56.90	58.40	58.40
Avg.	23.48	22.29	21.99	23.04	25.02	27.44	34.39	44.42	48.40	49.34	54.40	55.48	57.65	58.40

* Price unchanged at $24.00 from 1941 through 1944.

CHICAGO FOUNDRY PIG IRON Per Gross Ton

	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925
Jan.	$23.88	$15.10	$16.25	$23.46	$14.47	$17.85	$19.00	$25.85	$18.46	$17.35	$19.00	$15.50	$14.00	$17.90	$13.75	$13.00	$16.50	$30.00	$33.00	$31.00	$40.00	$31.50	$18.90	$28.90	$23.70	$24.00
Feb.	23.85	14.90	16.86	23.36	13.91	17.85	19.41	25.85	18.16	16.75	19.00	15.50	14.00	17.31	14.00	13.00	16.50	32.00	33.00	31.00	42.25	29.00	19.00	29.75	24.50	24.00
Mar.	23.86	15.60	16.51	23.22	14.06	17.80	19.35	26.10	17.85	16.50	18.30	15.50	14.00	17.25	14.25	12.95	16.70	36.00	33.00	29.94	43.00	25.60	20.00	31.25	24.38	23.90
Apr.	23.72	15.86	16.97	22.87	14.35	17.60	19.10	26.35	17.73	16.50	17.50	15.00	14.00	17.00	14.25	13.00	19.00	39.25	33.00	26.75	43.00	24.90	20.50	32.00	24.10	22.50
May	22.66	15.86	20.66	20.72	13.86	17.60	18.90	26.86	17.63	16.50	17.06	15.00	14.50	16.00	14.06	13.00	19.00	43.80	33.00	26.75	43.00	22.60	22.60	32.00	22.75	21.13
June	20.72	15.35	21.66	19.85	13.70	17.00	18.64	26.00	17.73	16.50	16.75	15.00	14.50	15.62	13.69	13.00	19.00	51.00	33.00	26.75	43.40	20.75	23.25	31.25	21.25	20.30
July	18.00	15.35	21.60	18.25	13.60	16.47	18.00	25.56	17.55	17.00	16.56	14.87	14.70	14.70	13.75	13.00	19.00	55.00	33.00	26.75	45.25	19.00	24.25	27.90	19.60	20.80
Aug.	16.25	15.35	22.10	17.22	13.60	16.00	18.45	24.85	17.35	17.13	16.50	14.50	15.37	15.00	13.69	13.44	18.40	55.00	33.00	26.75	46.00	19.55	25.60	27.00	20.38	20.50
Sept.	15.35	15.35	23.35	16.41	13.85	16.00	20.16	24.10	17.06	18.70	16.40	14.50	16.00	15.00	13.25	13.90	18.13	54.87	33.00	26.75	46.00	21.75	32.00	26.75	20.50	21.00
Oct.	14.85	15.10	23.36	15.70	14.10	17.06	21.46	22.45	16.85	19.00	16.00	14.46	17.00	15.00	12.94	14.63	19.43	33.00	34.00	27.75	44.50	21.00	31.40	25.90	20.50	21.63
Nov.	14.85	15.23	23.35	15.10	15.90	19.15	24.70	20.60	17.10	19.00	16.00	14.09	17.75	14.87	12.56	17.13	25.80	33.00	34.00	31.00	39.40	20.60	29.75	23.13	21.00	22.75
Dec.	15.10	15.66	23.35	14.81	16.95	19.00	25.85	18.80	17.35	19.00	16.00	14.00	18.00	14.30	13.00	16.10	29.50	33.00	34.00	30.75	34.50	19.63	26.00	23.00	22.50	23.00
Avg.	19.47	15.38	20.87	19.25	14.37	17.65	20.43	24.90	17.57	17.49	17.09	14.83	15.32	15.53	13.65	14.01	20.26	41.31	33.25	29.16	42.53	22.93	24.85	28.16	22.10	22.09

	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940*	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954
Jan.	$23.00	$20.88	$18.50	$20.00	$20.00	$17.50	$16.50	$15.50	$17.50	$18.50	$19.50	$21.00	$24.00	$21.00	$23.00	$24.00	$25.75	$30.00	$39.75	$46.00	$46.50	$52.50	$52.50	$55.00	$56.50
Feb.	23.00	20.25	19.50	20.00	20.00	17.50	15.50	15.50	17.50	18.50	19.50	21.25	24.00	21.00	23.00	24.50	25.75	30.50	39.00	46.50	46.50	52.50	52.50	55.00	56.50
Mar.	23.00	20.00	18.50	20.00	19.50	17.50	16.50	15.50	17.50	18.50	19.50	23.00	24.00	21.00	23.00	25.00	26.13	33.00	39.00	46.50	46.50	52.50	52.50	55.00	56.50
Apr.	22.00	20.00	18.50	20.00	19.40	17.50	16.00	15.50	17.75	18.50	19.50	24.00	24.00	21.00	23.00	25.00	26.50	33.00	39.00	46.50	46.50	52.50	52.50	55.00	56.50
May	21.63	20.00	18.20	20.00	19.00	17.50	16.00	15.50	18.50	18.50	19.50	24.00	24.00	21.00	23.00	25.00	26.50	33.00	39.00	46.50	46.50	52.50	52.50	55.00	56.50
June	21.10	20.00	18.00	20.00	18.30	17.50	16.00	15.50	18.50	18.50	19.50	24.00	23.20	21.00	23.00	25.00	26.50	33.00	39.00	46.50	46.50	52.50	52.50	55.00	56.50
July	21.00	20.00	17.60	20.00	17.90	17.50	15.50	15.70	18.50	18.50	19.50	24.00	20.00	21.00	23.00	25.00	26.50	34.20	42.00	46.50	46.50	52.50	53.00	56.50	56.50
Aug.	21.00	19.50	17.60	20.00	17.50	17.50	15.50	17.10	18.50	18.50	19.50	24.00	20.00	21.00	23.00	25.00	26.50	36.00	43.00	46.50	46.50	52.50	55.00	56.50	56.50
Sept.	21.00	19.50	18.25	20.00	17.50	17.50	15.50	17.50	18.50	18.50	19.50	24.00	20.25	22.00	23.00	25.00	26.50	36.00	43.00	46.50	47.50	52.50	55.00	56.50	56.50
Oct.	21.00	19.00	18.00	20.00	17.50	17.50	15.50	17.50	18.50	18.75	19.50	24.00	21.00	23.00	23.00	25.30	26.50	36.00	46.50	46.50	49.50	52.50	55.00	56.50	56.50
Nov.	21.00	18.50	20.00	20.00	17.50	17.50	15.50	17.50	18.50	19.50	19.75	24.00	21.00	23.00	23.00	25.75	26.50	36.00	46.50	46.50	49.50	52.50	55.00	56.50	56.50
Dec.	21.00	18.50	20.00	20.00	17.50	16.70	15.50	17.50	18.50	19.50	20.50	24.00	21.00	23.00	23.40	25.75	30.10	36.40	46.50	46.50	52.50	52.50	55.00	56.50	56.50
Avg.	21.84	19.68	18.84	20.00	18.47	17.43	15.58	16.47	18.19	18.68	19.60	23.48	22.20	21.99	23.03	25.02	27.84	34.80	41.77	46.90	47.58	52.50	53.75	55.75	56.50

* Price unchanged at $24.00 from 1941 through 1944.

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- Does your scrap total 3 or 300 tons a day?
- Is it steel, copper, brass, aluminum, or what?
- Is it skeleton, trim, partially formed shapes, turnings, or what?
- Do you require automatic operation or can the tonnage be handled by manually controlled presses?
- Do you require higher than standard pressures or extreme densities?
- Do you have any special problems such as limited area, scrap handling, or handling of bales?

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June, 1955

M-23

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Alter Company

ESTABLISHED 1898

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Telephone 6-2561

Open letter to Nickel consumers

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The scarcity of nickel and its alloys and the prices of these commodities has been a subject of much concern and comment both here and abroad. Nickel and its alloys are essential ingredients in the manufacture of both military and civilian goods and, as such, maintains a position of utmost importance in the metallurgical field. The scarcity of nickel is something about which we are very much concerned and we are attempting to the best of our ability to alleviate part of the shortage.

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We are doing everything possible to supply domestic industry with nickel alloy products which will best suit their needs. Where supplies are in excess of domestic demand, we are willing and able to supply friendly foreign nations with nickel alloys wherever it is consistent with the policies of our Government.

We welcome your inquiries and will do everything possible to fill your requirements where the supply of raw materials permits.

Very truly yours,

ALTER COMPANY

Arant H. Sherman

By: Arant H. Sherman,
Vice President

AHS:ph

STRETCHING AMERICA'S SUPPLY OF VITAL METALS

SPIEGELEISEN, 19 TO 21 PCT Per Gross Ton

	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931
Jan.	$25.00	$25.00	$30.38	$60.00	$60.00	$66.00	$51.40	$45.00	$26.00	$34.40	$38.00	$33.00	$32.00	$37.00	$30.00	$31.00	$31.00	$28.00
Feb.	25.00	25.00	36.25	66.75	61.25	60.75	56.75	40.00	26.00	36.50	38.00	33.00	32.00	37.00	31.00	31.00	31.00	28.00
Mar.	25.00	25.00	57.00	75.00	71.25	47.00	60.00	35.00	29.40	40.00	38.00	33.00	32.00	37.00	31.00	31.00	31.00	28.00
Apr.	25.00	25.00	65.00	75.00	90.75	45.00	67.60	34.00	32.25	40.00	36.00	33.00	32.00	37.00	31.00	31.00	31.00	28.00
May	25.00	25.00	65.00	81.00	84.00	37.40	75.00	32.00	36.00	42.50	36.00	33.00	32.00	36.25	31.00	31.00	31.00	28.00
June	25.00	25.00	61.00	82.50	69.00	31.25	75.00	32.00	36.00	40.50	35.00	32.00	32.00	36.50	31.00	31.00	31.00	28.00
July	25.00	25.00	52.50	85.00	69.00	35.00	75.00	27.00	36.00	44.00	34.20	32.00	32.00	33.00	31.00	31.00	31.00	28.00
Aug.	25.00	25.00	48.00	85.00	69.00	35.00	69.00	26.00	37.00	46.75	32.50	32.00	32.00	33.00	32.50	31.00	31.00	28.00
Sept.	25.00	26.00	45.00	82.50	63.75	35.00	62.00	26.00	36.25	43.75	31.40	31.00	32.00	33.00	33.00	31.00	31.00	28.00
Oct.	25.00	29.25	42.75	76.25	62.00	35.00	61.88	26.00	36.00	43.75	30.75	31.25	32.00	30.75	33.00	31.00	31.00	28.00
Nov.	25.00	29.25	45.40	68.00	60.25	37.00	75.62	26.00	37.00	41.25	30.25	32.00	37.40	30.00	30.00	31.00	30.50	28.00
Dec.	25.00	29.25	55.00	60.00	74.38	40.00	69.10	26.00	37.00	39.00	32.00	32.00	36.50	30.00	31.00	31.00	29.40	28.20
Avg.	25.00	26.20	50.02	74.75	75.72	42.03	70.11	31.25	34.31	42.67	34.41	32.40	32.83	34.17	31.36	31.00	30.74	27.85

	1932	1933	1934	1935	1936	1937	1938	1939	1940*	1946	1947	1948	1949	1950	1951	1952	1953	1954
Jan.	$28.00	$24.00	$27.00	$26.00	$26.00	$26.00	$33.00	$28.00	$32.00	$36.00	$40.00	$47.00	$62.00	$65.00	$75.00	$75.00	$85.00	$86.00
Feb.	28.00	24.00	27.00	26.00	26.00	26.00	33.00	28.00	32.00	36.00	40.00	47.00	62.00	65.00	75.00	75.00	86.00	86.00
Mar.	28.00	24.00	26.50	26.00	26.00	28.40	33.00	28.00	32.00	36.00	42.00	48.00	63.20	65.00	75.00	75.00	86.00	86.00
Apr.	28.00	24.00	26.00	26.00	26.00	30.00	33.00	28.00	32.00	36.00	44.00	52.00	65.00	65.00	75.00	75.00	86.00	86.00
May	26.00	24.00	26.00	26.00	26.00	32.25	33.00	28.00	32.00	36.00	44.00	52.00	65.00	65.00	75.00	75.00	86.00	86.00
June	25.75	24.00	26.00	26.00	26.00	33.00	33.00	28.00	34.40	36.00	44.00	52.00	65.00	65.00	75.00	75.00	86.00	86.00
July	25.00	27.00	26.00	26.00	26.00	33.00	28.00	28.00	36.00	36.00	44.00	52.00	65.00	65.00	75.00	75.00	86.00	86.00
Aug.	25.00	27.00	26.00	26.00	26.00	33.00	28.00	28.00	36.00	36.00	46.25	53.00	65.00	65.00	75.00	82.00	86.00	86.00
Sept.	25.00	27.00	26.00	26.00	26.00	33.00	28.00	31.00	36.00	36.00	47.00	60.75	65.00	67.00	75.00	85.00	86.00	86.00
Oct.	25.00	27.00	26.00	26.00	26.00	33.00	28.00	32.00	36.00	36.00	47.00	62.00	65.00	70.00	75.00	85.00	86.00	86.00
Nov.	24.40	27.00	26.00	26.00	26.00	33.00	28.00	32.00	36.00	36.00	47.00	62.00	65.00	70.00	75.00	85.00	86.00	86.00
Dec.	24.00	27.00	26.00	26.00	26.00	33.00	28.00	32.00	36.00	40.00	47.00	62.00	65.00	72.50	75.00	86.00	86.00	86.00
Avg.	25.35	25.50	26.21	26.00	26.00	31.14	30.00	29.25	34.20	36.50	44.35	54.15	64.35	66.66	75.00	78.00	85.58	86.00

* 1941-1945—36.00.

FERROMANGANESE, 80 PCT Per Gross Ton, Eastern Producers

	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930
Jan.	$36.04	$41.00	$66.00	$44.40	$66.00	$150.00	$175.00	$250.00	$255.00	$146.00	$112.50	$66.35	$105.00	$100.70	$112.50	$115.00	$100.00	$100.00	$105.00	$100.00
Feb.	37.00	41.00	65.00	39.25	69.75	207.50	231.25	250.00	215.00	172.50	100.00	60.42	107.50	107.50	115.00	115.00	100.00	100.00	105.00	95.50
Mar.	37.10	41.00	65.00	38.50	100.00	349.40	290.00	250.00	175.00	216.25	90.00	62.50	113.75	107.50	115.00	97.50	100.00	100.00	105.00	94.40
Apr.	36.75	43.00	61.00	36.00	100.00	406.25	362.50	290.00	150.00	240.00	90.00	64.37	120.00	107.50	115.00	88.00	100.00	100.00	105.00	94.40
May	36.50	47.50	61.00	36.00	100.00	387.50	420.50	290.00	138.40	250.00	85.00	66.67	120.00	107.50	115.00	88.00	94.00	100.00	105.00	94.40
June	36.50	49.25	61.00	36.00	100.00	270.00	443.75	290.00	121.00	225.00	80.00	67.50	120.75	107.50	115.00	88.00	90.00	105.00	105.00	94.40
July	36.50	48.88	59.00	37.20	100.00	175.00	406.25	290.00	111.00	225.00	70.60	67.50	*119.50	108.50	115.00	88.00	90.00	105.00	105.00	94.40
Aug.	36.70	52.40	56.38	100.33	127.25	172.00	400.00	290.00	101.25	195.75	70.00	67.50	*117.50	95.75	115.00	88.00	90.00	105.00	105.00	94.40
Sept.	37.75	59.63	56.00	90.00	117.00	169.75	387.50	285.00	96.75	170.00	66.00	75.63	*111.25	90.00	115.00	88.00	90.00	105.00	105.00	94.40
Oct.	38.80	67.80	50.10	70.40	105.00	162.25	310.00	285.00	105.00	170.00	63.00	100.00	*110.00	90.00	115.00	88.00	90.00	105.00	105.00	94.40
Nov.	38.40	73.75	50.00	68.00	105.00	160.00	256.00	285.00	112.50	170.00	61.50	100.00	*106.75	90.75	115.00	96.50	90.00	105.00	105.00	94.40
Dec.	38.75	75.00	47.00	72.20	106.00	169.75	243.75	275.00	122.50	135.00	60.00	100.00	*105.25	107.00	115.00	100.00	100.00	105.00	105.00	82.00
Avg.	37.51	53.35	59.29	56.86	105.83	231.70	327.21	277.50	142.12	193.21	79.53	74.22	114.85	102.85	114.79	95.02	94.50	103.17	105.00	93.99

	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941	1942*	1947	1948	1949	1950	1951	1952	1953	1954
Jan.	$80.00	$75.00	$80.00	$85.00	$85.00	$75.00	$80.00	$102.50	$85.00	$100.00	$120.00	$120.00	$135.00	$145.00	$161.40	$173.40	$185.24	$186.25	$226.25	$224.00
Feb.	80.00	75.00	80.00	85.00	85.00	75.00	80.00	102.50	80.00	100.00	120.00	120.00	135.00	145.00	161.40	173.40	186.25	186.25	226.25	224.00
Mar.	80.00	75.00	80.00	85.00	85.00	75.00	80.00	102.50	80.00	100.00	120.00	120.00	135.00	145.00	169.35	173.40	186.25	186.25	226.25	224.00
Apr.	80.00	75.00	80.00	85.00	85.00	75.00	90.00	102.50	80.00	100.00	120.00	120.00	135.00	145.00	173.40	173.40	186.25	186.25	226.25	224.00
May	80.00	75.00	80.00	85.00	85.00	75.00	100.62	102.50	80.00	100.00	120.00	120.00	135.00	145.00	173.40	173.40	186.25	186.25	226.25	224.00
June	80.00	68.00	80.00	85.00	85.00	75.00	102.50	102.50	80.00	110.00	120.00	120.00	135.00	135.00	145.00	173.40	173.40	186.25	186.25	224.00	224.00
July	80.00	68.00	82.00	85.00	85.00	75.00	102.50	92.50	80.00	120.00	120.00	120.00	135.00	135.00	145.00	173.40	173.40	186.25	186.25	224.00	224.00
Aug.	80.00	68.00	82.00	85.00	85.00	75.00	102.50	92.50	80.00	120.00	120.00	120.00	135.00	135.00	145.00	173.40	173.40	186.25	216.25	224.00	224.00
Sept.	80.00	68.00	82.00	85.00	85.00	75.00	102.00	92.00	95.00	120.00	120.00	120.00	135.00	135.00	145.00	173.40	173.40	186.25	226.25	224.00	212.00
Oct.	80.00	68.00	82.00	85.00	85.00	75.00	102.50	92.50	100.00	120.00	120.00	120.00	135.00	145.00	162.00	173.40	173.40	186.25	226.25	224.00	212.00
Nov.	80.00	68.00	82.00	85.00	85.00	80.00	102.00	92.00	100.00	120.00	120.00	120.00	135.00	145.00	162.00	173.40	173.40	178.60	186.25	226.25	226.00	212.00
Dec.	73.60	68.00	82.00	85.00	85.00	80.00	102.50	92.50	100.00	120.00	120.00	120.00	135.00	145.00	162.00	173.40	161.20	186.25	226.25	224.00	212.00
Avg.	79.47	70.92	75.00	85.00	85.00	75.83	96.84	97.50	86.67	110.84	120.00	120.00	135.00	140.25	171.06	174.48	166.16	202.06	224.00	220.27

* Price at furnace, where lower than price at seaboard.
† Seaboard price prior to Oct. 7, 1948.
* Price unchanged at $135.00 from 1943 through 1946.
Effective prices are converted from quoted cents per lb.


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The Iron Age heavy melting steel scrap price composite, Machinery cast at Chicago, No. 1 at Chicago, Philadelphia and Pittsburgh.

THE IRON AGE STEEL SCRAP COMPOSITE Per Gross Ton†

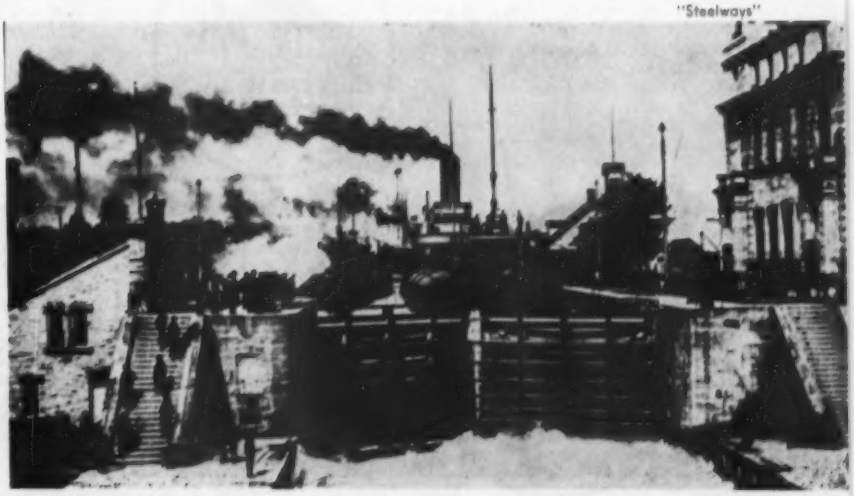
	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927
Jan.	$19.75	$11.46	$16.19	$16.81	$18.12	$11.85	$15.84	$16.90	$12.50	$11.77	$14.02	$10.29	$10.27	$16.46	$21.73	$29.93	$17.77	$25.13	$15.04	$12.48	$20.22	$19.15	$20.10	$16.97	$19.17
Feb.	19.62	12.31	15.79	15.92	17.50	13.54	14.92	16.42	13.15	11.46	13.06	11.39	10.39	16.10	21.35	29.92	14.75	26.00	15.21	12.46	21.46	19.21	18.27	15.90	14.56
Mar.	20.62	13.17	15.99	14.50	17.62	12.58	13.27	16.10	13.43	11.71	13.10	11.10	10.73	17.23	23.60	29.88	14.52	25.50	13.17	13.46	24.79	17.90	18.92	15.53	14.66
Apr.	20.20	13.19	15.96	14.90	17.46	12.20	13.20	15.59	12.63	12.44	13.39	10.63	10.61	17.42	25.63	28.47	15.79	24.42	11.63	14.71	24.00	15.20	18.48	15.27	14.71
May	19.81	11.48	14.50	14.93	17.95	12.08	14.33	14.84	12.67	12.85	12.30	10.90	10.79	16.47	27.63	28.79	15.06	23.71	12.20	15.67	20.77	14.71	18.48	14.35	13.95
June	19.00	10.85	13.47	14.84	17.79	12.67	15.33	14.23	12.06	12.94	11.60	10.57	10.76	15.25	37.21	28.67	16.54	23.47	11.47	15.52	18.94	14.68	18.08	14.40	13.60
July	18.33	10.29	13.97	14.92	17.27	13.27	15.25	13.67	12.21	12.82	11.42	10.50	11.05	15.19	36.00	28.00	19.13	24.21	11.00	15.92	17.23	16.00	16.46	15.42	13.48
Aug.	17.29	10.79	14.52	15.78	16.57	13.73	16.06	13.43	12.50	13.19	11.46	10.42	13.00	15.35	31.30	29.00	20.25	25.08	11.57	16.30	16.58	16.58	17.23	15.88	13.80
Sept.	15.62	11.13	15.32	17.11	16.21	14.15	16.93	13.50	11.94	13.73	11.35	10.30	13.79	15.67	31.50	29.00	18.67	26.63	12.15	16.33	16.98	17.38	17.42	16.25	13.92
Oct.	13.96	12.00	15.85	17.28	15.72	14.55	17.46	13.44	11.27	14.90	11.00	9.71	13.62	16.90	26.00	29.00	18.67	23.73	12.90	16.20	16.15	17.08	17.08	15.58	13.48
Nov.	12.12	13.85	16.75	18.07	13.46	15.56	17.17	13.30	11.02	14.69	10.39	9.13	14.63	20.40	27.63	28.50	20.50	20.00	12.73	16.02	15.13	18.17	17.63	15.25	13.18
Dec.	10.48	15.52	16.79	16.86	12.00	16.32	17.17	12.75	11.52	14.00	9.97	9.50	16.20	24.13	28.07	28.50	22.77	15.92	12.29	17.94	17.37	20.08	17.37	15.06	13.48
Avg.	17.20	12.15	15.43	16.11	16.44	13.54	15.58	14.80	12.19	13.04	11.92	10.36	12.21	17.22	26.35	28.76	17.99	23.71	12.61	15.83	19.06	17.16	17.13	15.48	14.00

	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941*	1942*	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954
Jan.	$13.70	$17.02	$14.65	$11.30	$8.41	$8.77	$11.73	$12.29	$13.47	$18.33	$14.00	$14.94	$17.58	$20.88	$19.17	$19.17	$19.17	$31.00	$40.81	$41.38	$26.88	$46.15	$42.00	$42.00	$28.67
Feb.	13.71	16.96	14.92	11.15	8.27	8.83	12.25	11.88	14.12	19.27	13.86	15.01	16.86	20.08	19.17	19.17	19.17	33.31	40.35	36.21	27.25	44.19	42.00	42.92	25.92
Mar.	13.65	16.71	14.68	11.10	8.23	8.96	12.82	11.06	14.75	21.25	13.46	15.20	16.86	20.29	19.17	19.17	19.17	30.88	40.00	35.43	28.05	43.00	42.00	44.15	23.83
Apr.	13.81	17.18	14.30	10.83	8.12	7.73	12.84	10.46	14.56	21.02	12.40	14.77	16.14	19.22	19.17	19.17	19.17	33.88	40.31	33.86	29.04	43.00	42.00	41.75	25.38
May	13.90	16.54	13.71	9.94	7.48	9.70	11.57	10.70	13.39	18.64	11.54	14.17	17.60	19.17	19.17	19.17	19.17	29.81	40.60	32.67	33.40	43.00	42.00	36.59	27.79
June	13.52	16.39	13.31	9.39	8.09	9.97	10.67	10.74	12.81	17.28	11.32	14.71	18.31	19.17	19.17	19.17	19.17	32.79	40.66	30.78	39.29	43.00	41.37	40.97	27.86
July	13.13	16.60	13.06	9.25	8.48	11.27	10.53	10.96	13.29	18.79	13.29	14.92	18.47	19.17	19.17	19.17	19.17	37.95	41.80	19.33	37.25	43.00	40.10	44.60	28.87
Aug.	13.75	16.86	13.29	9.25	8.93	12.08	10.15	12.25	15.04	20.43	14.51	15.43	18.72	19.17	19.10	19.17	19.17	39.48	43.16	20.85	38.85	43.00	42.00	42.46	28.33
Sept.	14.75	16.00	13.70	9.12	7.89	11.35	9.83	12.71	16.45	18.73	14.34	16.32	19.91	19.17	17.57	19.17	19.17	37.77	43.16	25.67	40.89	43.00	42.00	36.53	29.71
Oct.	15.85	15.78	12.77	8.78	7.62	10.56	9.54	12.67	16.63	15.89	14.21	21.48	20.63	19.17	15.57	19.17	19.17	40.69	43.16	28.40	40.67	42.80	42.00	32.67	32.53
Nov.	15.73	14.83	11.89	8.74	7.45	9.94	10.04	12.90	16.31	13.34	14.74	19.66	20.63	19.17	16.54	19.17	23.34	41.21	43.04	29.98	40.96	42.00	42.00	35.21	33.46
Dec.	15.97	14.15	11.28	8.61	6.92	10.50	11.43	13.33	17.10	13.46	14.88	18.05	21.42	19.17	19.04	19.17	28.23	40.09	43.00	27.15	44.02	42.00	42.00	31.33	32.46
Avg.	14.29	16.30	13.46	9.80	7.84	9.47	11.67	11.85	14.83	18.03	13.84	16.39	18.57	19.49	18.55	19.18	20.27	38.38	41.65	27.86	34.76	43.18	41.79	39.82	28.89

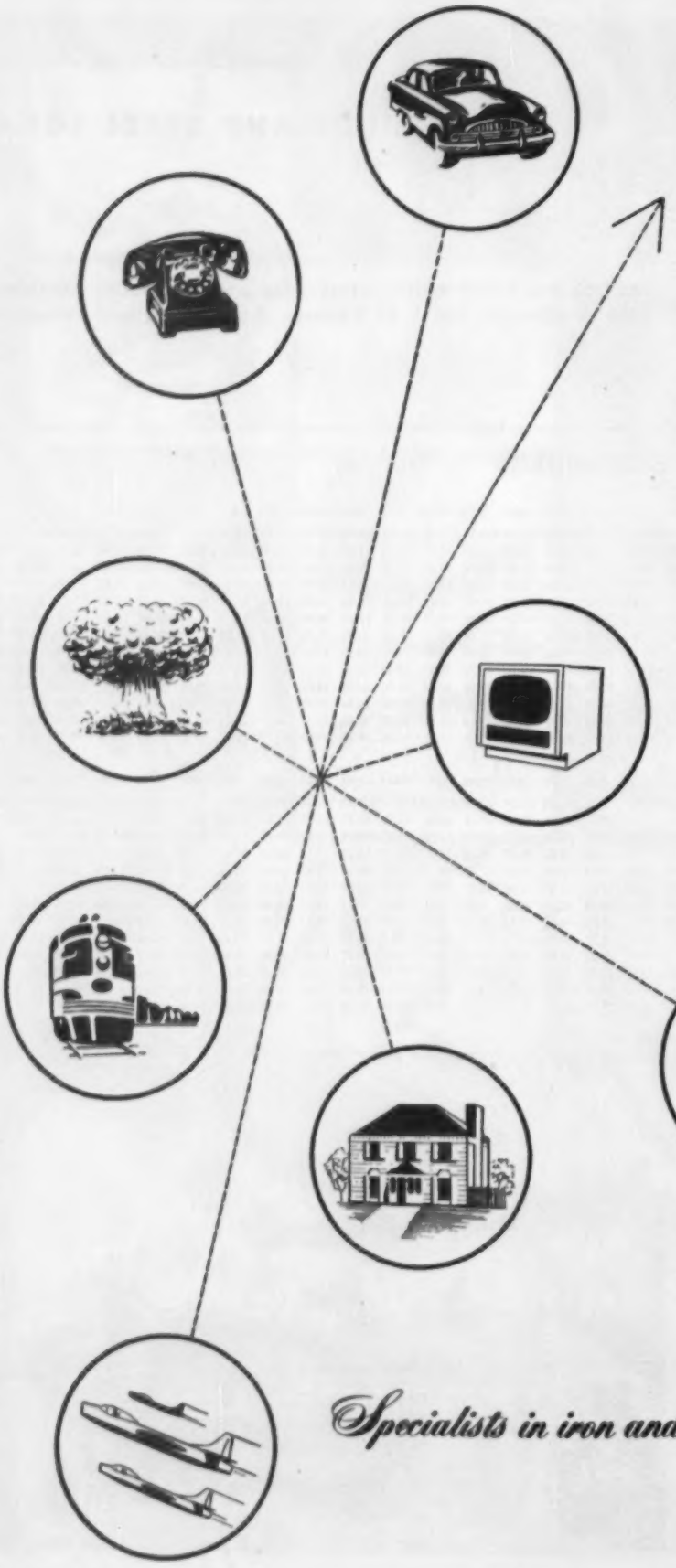
* Price unchanged at $19.17 throughout 1942 and 1943.

† Average of No. 1 Heavy melting steel scrap delivered Chicago, Philadelphia and Pittsburgh.

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CHICAGO MACHINERY CAST SCRAP Per Gross Ton, Delivered

	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933
Jan.	$13.31	$15.50	$25.90	$22.95	‡37.25	$17.25	$12.90	$21.60	$20.38	$19.88	$17.00	$16.50	$14.50	$16.81	$13.50	$ 9.50	$ 7.75	$ 6.25
Feb.	12.81	15 37	26.06	20 00	35 88	18 00	13 25	23 63	21.00	18.75	17.00	16.50	14.50	16 25	13.75	9.50	7.50	6.25
Mar.	13.45	16.90	27.25	21 63	37 85	14 90	14 13	26 25	20 13	18 20	17.00	16 50	14.50	16.00	13.75	9.50	7.20	6.25
Apr.	12.88	20.43	27.12	21.45	37.25	13 25	14.88	25 75	18.40	17.25	16.39	16 50	14.13	16.00	13.50	9.39	7.00	7.06
May	12 56	23 26	26.70	20.12	37 38	13.00	16 23	23 30	17.38	16 88	15 88	15.00	14.00	13 39	12 88	9.00	6.50	8.45
June	11.75	33.00	27.12	20 75	36 30	12.75	16 08	21.75	16 75	17.50	16.15	14 50	13.88	14.75	12.50	9.00	6.13	8.75
July	11.63	29 25	26.06	23 30	36 50	12.25	17 00	19 60	16 90	17.50	17.19	14.50	13.50	14.50	12 00	9 00	6 00	10.63
Aug.	11.50	24.20	29.10	24 50	36 20	12 60	16 60	18.00	17.50	17 63	17.00	14 80	13.94	14 50	12 00	9 00	6.10	10.50
Sept.	12.13	23.75	30.00	24 20	34 00	13 44	21 38	19 63	16 20	17.90	16.88	14.56	14 81	14 50	11.40	8.50	6.25	10.00
Oct	13.50	20.50	30 36	25.00	28 75	13 88	23 63	18 70	17.50	17 63	16.80	14.25	15.43	14.50	10.63	8 50	6.25	9.88
Nov.	15.55	22.00	28.87	28 12	23 00	13 50	20 25	18 38	17.88	18 19	16 00	13.50	15 50	13 63	9.36	8.50	6.25	9.00
Dec.	16.25	23.50	25 75	32 35	18 70	12 63	19.75	19.75	19 20	17 25	16.13	14 00	15 80	13 50	9.50	8.50	6 25	8.75
Avg.	13.10	22.06	27.69	23 70	33 51	14 00	17.10	21.38	18 43	17.88	16 89	15 16	14.52	14 94	12.06	8.90	6.60	8.45

	1934	1935	1936	1937	1938	1939	1940	1941*	1946	1947	1948	1949	1950	1951	1952	1953	1954
Jan.	$ 9.50	$10.60	$12.03	$15 87	$12 50	$12.56	$14.00	$18 88	$20.00	$43.38	$60.00	‡57.25	$38.50	$63.00*	$52 00*	$46.03	$35.75
Feb.	9.50	10 60	12 75	16 25	12.19	12.75	13.75	19 25	20.00	44.56	65.25	46.00	39.00	52.00*	52.00*	46.50	36.20
Mar.	9.50	9 38	13.10	17 40	11 65	12.75	13.38	20.75	20.00	46 00	68 50	41.20	39.75	52.00*	46.63†	47.20	36.20
Apr.	9.50	9 60	12.50	17 12	10 88	12.12	14.81	‡22.33	20.00	42 70	73.12	29.63	41.50	52 00*	43.45†	46.83	39.38
May	8.90	9 60	12 00	15 25	10.75	11.75	16.31	21.40	20.00	38 00	72.50	27.90	45.70	52 00*	43 00†	42.38	41.25
June	7.50	9 00	12 00	15 00	10.45	12.15	17.31	20.00	20.00	41.81	69.90	28 69	47.25	52 00*	41.23†	43.30	40.90
July	8 05	9 30	12.12	15 75	12.05	12.25	16 75	20 00	20.00	46 00	71.50	30 75	45 50	52 00*	39.10†	45 63	39.50
Aug.	8 00	10 87	13 37	16.55	13 35	12.25	16 88	20 00	20.00	49 38	74 30	39 30	49 10	52 00*	44.90†	45 25	39.50
Sept.	8 00	11.19	13.60	14 38	13 00	14.50	17.13	20.00	22.50	49.50	71 25	42.25	50 25	52 00*	45.50†	38 20	41.25
Oct.	8 00	11 25	14.00	13 18	12 25	16.87	17.75	20.00	25.00	51.00	69 87	41.25	52 50	52 00*	45 90†	38 75	43.25
Nov.	8 25	11.50	14 00	11 65	12.60	15.65	18.00	20.00	32.28	52.75	72 20	43 88	60.38	52.00*	45.19†	38.50	42.50
Dec.	9 65	11.80	14 75	12.12	12.50	14.50	19.13	20.00	41.06	60 30	69.50	39 85	64 50	52.00*	43.30†	38.00	43.63
Avg.	8 73	10 24	13.02	15.04	12.01	13.34	15.28	20.21	23.49	47.12	70 48	39.00	47.85	52.92	45.18	42.73	39.74

* Price unchanged at $20.00 from 1942 through 1945. Ceiling prices do not include delivery costs.
† Delivered. Nominal $3 per ton deducted for shipping, commission to put prices on F.o.b. basis for comparison purposes.
‡ Changed from net ton basis April 30, 1941.
* OPS ceiling shipping point prices.

PITTSBURGH HEAVY MELTING SCRAP No. 1, Per Gross Ton, Delivered

	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926
Jan.	$20.00	$13.00	$17.40	$21.20	$12.50	$16.25	$17.25	$18.95	$12.80	$16.63	$17.60	$13.50	$12.75	$14.95	$10.90	$11.63	$17.50	$22.60	$30.00	$18.00	$26.30	$15.50	$14.30	$21.80	$21.38	$21.50	$18.63
Feb.	21.00	14.50	17.63	21.13	13.50	15.88	16.31	18.06	13.88	15.63	17.25	14.13	12.12	14.19	12.62	11.63	17.06	21.75	30.00	14.75	27.75	16.00	14.00	23.25	20.06	19.50	17.50
Mar.	21.50	16.00	18.50	21.00	14.00	15.90	14.70	18.00	13.19	14.19	16.80	14.35	12.62	14.19	12.12	12.00	18.45	23.25	30.00	14.00	27.25	14.00	16.13	26.38	19.38	18.50	17.85
Apr.	21.00	16.50	19.00	21.50	13.63	16.00	14.75	17.94	12.80	14.00	16.50	13.06	13.06	14.19	12.00	11.81	17.81	28.00	28.50	15.20	26.00	12.63	16.38	25.88	18.20	17.00	16.63
May	17.00	17.00	20.00	21.25	12.13	15.00	14.80	18.10	12.81	14.81	15.30	12.62	13.25	13.55	12.00	11.75	16.95	28.80	28.50	14.75	25.00	13.30	17.30	22.80	15.63	16.75	15.69
June	18.00	17.50	21.25	20.00	11.30	13.90	15.63	18.38	13.13	15.69	15.10	12.95	13.44	12.62	12.00	11.75	15.08	41.00	28.62	17.12	25.00	12.69	17.00	21.13	16.00	17.30	15.75
July	13.00	17.00	21.90	19.70	10.75	14.00	15.75	18.08	14.25	15.90	14.80	13.06	13.34	12.40	12.00	12.31	16.31	30.00	29.00	19.70	26.00	12.00	17.38	18.10	17.50	18.00	16.81
Aug.	12.00	16.00	21.00	18.50	11.38	14.85	16.50	17.75	14.81	16.31	14.31	13.20	13.56	12.37	11.50	13.81	16.05	32.63	29.00	21.00	28.13	12.70	17.75	17.75	17.50	18.88	17.50
Sept.	11.00	16.00	21.50	17.25	11.50	15.88	16.56	17.38	14.25	17.40	14.35	12.50	14.11	12.25	11.31	14.30	16.19	33.25	29.00	19.20	29.00	13.63	20.13	17.56	18.10	18.70	17.56
Oct.	12.00	17.50	21.50	18.30	12.25	16.50	17.13	17.10	16.20	17.94	14.25	12.06	15.55	11.85	10.85	14.38	18.25	28.50	29.00	19.00	27.75	14.13	21.40	16.70	18.50	18.50	17.25
Nov.	12.00	16.00	21.00	13.25	14.25	17.50	18.00	14.88	16.06	17.50	14.25	12.00	15.12	11.44	10.00	15.06	21.20	29.50	28.87	22.25	23.50	14.30	20.50	16.13	19.63	19.50	17.20
Dec.	12.50	17.50	21.00	11.20	16.20	17.63	20.00	13.00	16.70	18.00	13.75	12.31	14.75	11.00	10.75	17.45	20.00	30.00	28.87	24.25	17.20	14.25	20.13	16.75	21.40	19.10	16.75
Avg.	15.67	16.29	20.14	18.44	12.76	15.77	16.48	17.30	14.51	16.17	15.34	12.98	13.66	12.92	11.50	13.23	18.14	29.90	28.95	18.35	25.74	13.76	17.82	20.38	18.51	18.60	17.19

	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941*	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954
Jan.	$16.88	$16.10	$19.31	$16.69	$13.19	$10.22	$ 8.30	$13.00	$13.38	$14.44	$19.80	$14.25	$15.72	$16.25	$22.13	$20.00	$20.00	$20.00	$32.25	$40.37	$41.25	$29.95	$47.13	$43.00	$43.00	$30.25
Feb.	16.13	14.94	18.63	16.81	12.88	10.25	8.50	14.00	13.06	14.96	19.81	14.13	15.72	17.50	21.00	20.00	20.00	20.00	34.94	40.43	39.25	31.25	46.78	43.00	43.75	27.25
Mar.	16.55	14.81	18.44	16.56	12.80	10.25	8.86	14.44	12.19	15.75	23.15	13.67	15.97	16.88	21.00	20.00	20.00	20.00	39.85	40.25	36.30	32.13	44.00	43.00	44.75	24.90
Apr.	16.50	15.31	18.60	15.95	12.39	10.12	10.00	14.19	11.55	15.75	22.25	12.44	15.31	16.85	20.20	20.00	20.00	20.00	35.40	40.25	24.94	33.00	44.00	43.00	42.63	26.50
May	16.40	15.25	17.88	15.25	11.25	9.80	11.75	12.80	11.62	14.50	19.38	11.50	14.46	16.37	20.00	20.00	20.00	20.00	30.38	40.25	23.00	37.75	44.00	43.00	39.00	30.25
June	14.81	14.88	18.25	15.13	10.30	8.75	11.75	11.75	11.75	13.57	18.45	11.30	15.12	20.06	20.00	20.00	20.00	20.00	33.88	40.25	22.00	44.50	44.00	42.90	42.10	29.50
July	15.00	14.10	18.56	14.75	10.58	8.25	12.72	11.75	11.85	14.19	19.75	14.25	15.56	16.10	20.00	20.00	20.00	20.00	38.45	40.87	20.75	41.50	44.00	40.45	46.75	28.50
Aug.	15.40	15.50	19.00	15.13	10.69	8.60	13.85	11.31	12.94	15.94	21.85	15.45	16.15	16.56	20.00	19.95	20.00	20.00	40.00	42.75	21.94	43.90	44.00	43.00	44.75	29.50
Sept.	15.50	16.56	18.31	15.60	10.65	8.94	12.94	10.75	13.25	17.80	19.62	15.25	16.00	20.00	20.00	18.25	20.00	20.00	37.75	42.75	27.35	43.75	44.00	43.00	39.30	31.00
Oct.	14.75	17.60	17.50	14.56	10.22	9.62	12.15	10.35	13.40	17.87	16.62	15.00	23.05	21.45	20.00	16.10	20.00	20.00	40.75	42.75	29.44	43.75	43.60	43.00	35.50	34.00
Nov.	14.25	17.19	16.39	13.19	10.22	9.15	11.50	10.94	13.56	17.31	13.75	15.28	20.56	21.89	20.00	17.13	20.00	23.94	41.88	42.75	31.85	43.75	43.00	43.00	37.25	34.29
Dec.	14.88	17.90	15.45	12.75	10.25	8.75	12.13	13.01	14.05	16.31	13.75	15.75	18.56	22.25	20.00	19.94	20.00	29.00	40.00	42.75	30.75	45.57	43.00	43.60	33.10	33.60
Avg.	15.50	15.74	18.01	15.29	11.25	9.43	11.21	12.36	12.72	15.67	18.99	14.02	17.10	19.23	20.90	19.38	20.00	21.96	37.13	41.36	28.06	39.16	44.21	42.76	40.99	29.90

* Price unchanged at $20.00 throughout 1942 and 1943.

PHILADELPHIA HEAVY MELTING SCRAP No. 1, Per Gross Ton, Delivered

	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926
Jan.	$20.00	$14.00	$18.30	$20.00	$11.86	$17.44	$17.33	$18.61	$11.70	$16.94	$17.00	$12.50	$12.19	$14.40	$10.40	$10.00	$16.38	$21.70	$30.00	$17.20	$24.75	$14.50	$11.60	$19.70	$18.20	$18.50	$17.00
Feb.	21.25	15.62	19.00	20.19	12.56	17.37	18.62	18.69	14.25	15.56	16.62	12.50	11.70	12.67	11.00	10.00	16.50	20.84	30.00	14.75	25.62	14.25	12.00	20.75	18.38	17.63	15.88
Mar.	21.90	16.09	20.12	20.75	14.00	17.62	18.69	18.87	13.12	13.50	16.88	14.06	11.90	13.25	11.31	10.80	16.90	23.60	29.00	14.19	25.20	13.00	12.78	25.25	18.75	15.90	16.00
Apr.	21.90	16.75	20.87	20.75	14.69	17.56	18.69	18.75	12.75	13.25	16.12	13.31	12.94	13.34	10.95	11.00	17.00	24.88	28.00	15.50	24.12	11.25	14.00	23.63	18.30	14.63	16.00
May	18.70	16.56	21.00	20.56	12.50	18.94	18.38	18.95	12.81	14.75	14.75	13.00	13.00	12.10	10.63	11.25	16.00	25.40	29.00	16.00	23.37	11.80	14.75	19.80	14.75	14.63	15.25
June	18.00	15.75	20.94	20.50	11.35	14.56	18.75	18.75	13.25	15.81	14.46	13.00	13.00	11.75	10.50	11.10	15.31	24.12	29.00	16.12	22.60	11.25	15.00	17.50	15.00	15.10	14.70
July	11.50	16.81	21.00	19.00	11.12	15.16	18.57	17.62	13.00	15.50	14.12	13.19	13.50	11.35	10.30	12.06	14.94	25.29	29.00	16.90	22.62	11.00	15.00	16.50	15.40	15.63	14.63
Aug.	10.90	16.70	20.50	17.37	11.75	15.56	18.75	16.85	14.50	16.87	13.75	13.15	13.05	11.43	10.19	13.75	14.75	31.88	29.00	19.37	25.00	11.40	16.20	16.00	16.75	16.38	16.20
Sept.	12.56	16.44	20.50	16.87	11.90	15.00	17.94	16.50	15.19	17.40	13.85	12.50	14.50	11.62	10.69	15.00	14.75	30.25	29.00	18.62	25.62	11.80	16.88	16.75	17.10	17.20	16.88
Oct.	12.62	17.50	20.85	13.85	12.67	16.56	18.12	16.35	15.00	18.00	13.81	11.94	15.19	11.15	9.95	14.75	15.63	28.00	29.00	19.10	22.75	12.06	17.80	15.40	16.63	16.75	16.50
Nov.	14.40	17.19	20.50	11.87	14.75	17.56	18.70	12.94	15.75	18.00	13.90	11.56	15.90	10.19	9.25	14.66	20.13	26.00	29.00	20.62	19.00	11.80	16.25	15.25	17.75	17.38	15.50
Dec.	16.75	17.81	20.25	11.25	16.20	17.50	19.50	11.50	17.10	17.50	12.65	12.00	15.25	10.00	9.40	15.81	23.75	28.20	25.00	22.50	18.25	11.50	16.38	16.75	20.10	17.50	15.50
Avg.	16.53	16.42	20.29	17.66	12.94	16.84	17.11	16.95	14.10	16.12	14.76	12.81	13.09	11.96	10.38	12.51	16.96	27.23	28.67	17.66	22.99	12.12	14.80	18.85	16.84	16.44	15.84

	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941*	1944*	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954
Jan.	$16.39	$13.50	$16.39	$14.50	$10.50	$7.00	$6.75	$11.70	$11.40	$12.62	$17.37	$14.75	$16.25	$18.00	$20.80	$18.75	$18.75	$18.75	$31.00	$42.50	$42.75	$23.10	$46.70	,41.50†	$41.50†	$27.63
Feb.	14.63	13.50	16.38	14.63	10.50	7.00	6.75	11.75	11.62	13.25	16.50	14.75	16.25	17.38	20.00	18.75	18.75	18.75	33.38	41.50	39.75	23.00	43.75	41.50†	42.50	25.00
Mar.	14.50	13.50	16.13	14.50	10.50	7.00	6.75	11.88	10.50	13.75	19.00	14.55	16.38	17.12	20.00	18.75	18.75	18.75	39.38	40.00	35.10	23.05	42.50†	41.50†	44.38	22.10
Apr.	14.50	13.50	17.00	13.95	10.31	7.50	7.19	11.00	10.00	13.00	20.00	13.37	15.62	16.75	19.00	18.75	18.75	18.75	33.10	41.50	23.00	25.38	42.50†	41.50†	42.75	21.50
May	14.10	13.50	16.38	13.38	9.60	6.00	8.90	10.95	10.44	12.81	18.62	12.13	15.25	17.56	18.75	18.75	18.40	18.75	29.00	42.31	22.00	28.70	42.50†	41.50†	40.50	22.75
June	14.00	13.38	16.00	12.75	9.10	6.00	9.25	10.50	10.00	12.00	17.20	12.20	15.41	19.00	18.75	18.75	18.25	18.75	33.63	42.00	19.50	34.63	42.50†	40.50	41.50	22.75
July	13.38	13.00	16.50	12.50	8.44	6.00	10.00	10.30	10.56	12.31	19.00	13.63	15.62	18.95	18.75	18.75	18.75	18.75	38.45	43.12	17.50	32.81	42.50†	40.65	43.00	23.25
Aug.	13.70	13.00	16.50	12.63	8.00	6.30	11.95	9.94	11.44	14.00	19.75	14.36	16.25	19.86	18.75	18.60	18.75	18.75	38.50	45.00	18.31	36.90	42.50†	41.50†	43.38	28.00
Sept.	14.00	14.75	16.38	13.00	8.50	7.25	11.25	9.63	12.38	15.40	19.00	14.25	16.87	20.50	18.75	18.66	18.75	18.75	36.50	45.00	23.35	38.50	42.50†	41.50†	35.90	28.13
Oct.	14.00	16.00	15.70	12.38	8.13	7.25	10.20	9.53	12.10	15.75	16.38	14.75	22.35	20.70	18.75	14.60	18.75	18.75	40.25	45.00	24.25	38.50	42.10†	41.50†	31.50	30.75
Nov.	13.80	15.50	15.00	11.75	8.00	7.25	9.75	9.94	12.13	15.12	13.75	14.75	20.75	20.75	18.75	15.00	18.75	22.94	42.63	44.75	24.50	39.44	41.50†	41.50†	34.50	32.70
Dec.	13.80	15.40	14.50	11.10	7.75	6.75	10.44	10.75	12.00	15.50	14.25	15.12	18.92	20.85	18.75	15.50	18.75	28.00	41.10	44.50	24.25	42.81	41.50†	41.50†	29.90	31.38
Avg.	14.13	14.06	16.07	13.12	9.18	6.78	9.16	10.71	11.30	13.85	17.79	14.05	17.08	18.96	19.13	17.81	18.68	19.87	36.50	43.20	28.19	32.27	42.75†	41.35	39.33	26.16

* Price unchanged at $18.75 throughout 1942 and 1943.
† OPS basing point price ceiling.

CHICAGO HEAVY MELTING SCRAP No. 1, Per Gross Ton, Delivered

	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927
Jan.	$18.06	$10.13	$14.88	$14.96	$16.90	$11.05	$13.94	$16.00	$11.75	$16.75	$12.60	$ 9.35	$ 9.19	$15.50	$21.12	$30.00	$17.40	$24.50	$18.13	$11.45	$19.15	$17.88	$19.44	$15.12	$13.25
Feb.	18.13	10.88	14.13	13.63	15.75	12.50	13.06	16.50	12.06	16.75	12.13	10.50	9.56	14.75	21.50	30.25	15.06	25.00	15.13	11.38	20.33	17.88	17.69	13.88	13.00
Mar.	18.31	11.50	14.45	13.00	16.00	11.44	12.13	15.00	12.15	16.94	12.06	9.81	9.63	16.50	23.70	29.87	15.63	24.25	12.50	12.38	23.80	16.56	16.45	13.96	12.90
Apr.	18.35	11.25	14.30	13.50	15.75	11.06	12.35	14.44	11.75	11.56	12.50	9.80	9.15	16.50	27.00	28.75	16.41	23.75	11.00	13.75	22.50	14.10	14.81	13.19	13.13
May	17.63	9.75	12.85	13.70	15.60	10.62	13.44	13.96	10.50	12.06	11.25	9.60	9.37	15.94	28.70	26.80	15.62	23.00	11.50	14.95	19.70	13.75	15.00	12.13	12.35
June	18.50	9.30	11.95	13.13	16.25	11.62	14.00	13.15	10.38	12.12	10.44	9.75	9.44	14.80	30.50	29.00	16.00	22.95	10.81	14.56	17.88	13.63	15.75	12.45	12.00
July	18.38	9.00	12.75	13.13	16.12	11.75	14.06	12.38	10.69	11.90	10.50	9.75	10.40	14.80	33.00	29.00	19.40	24.13	10.00	15.25	17.06	14.90	15.00	14.19	12.06
Aug.	18.00	9.25	13.15	14.10	16.10	12.68	15.00	12.25	11.06	12.25	10.96	9.69	11.56	15.25	29.60	29.00	20.00	25.38	10.60	15.95	16.00	15.50	16.44	14.00	12.30
Sept.	13.75	10.00	14.38	16.50	14.75	13.00	16.00	12.25	10.70	12.81	10.06	9.19	11.75	16.06	31.25	29.00	19.10	24.81	11.31	16.13	16.31	16.40	16.35	14.00	12.25
Oct.	12.88	10.88	14.50	16.60	14.70	13.45	16.43	12.25	10.00	13.95	10.00	8.50	11.75	16.81	29.00	29.00	18.25	21.50	12.44	16.40	14.15	16.13	16.00	13.00	11.69
Nov.	11.25	12.55	15.20	17.50	12.63	14.88	16.00	12.25	9.75	13.69	9.56	8.06	13.44	20.80	27.50	28.50	20.88	18.45	12.25	17.31	14.80	17.13	16.00	13.00	11.50
Dec.	9.88	14.15	16.25	17.13	11.50	15.17	16.00	12.10	10.25	12.88	9.00	8.43	15.63	23.00	28.38	22.75	21.50	18.20	11.13	17.25	16.06	16.95	15.75	13.00	12.06
Avg.	15.51	10.72	13.96	14.74	15.00	12.46	14.46	13.43	10.92	12.12	10.89	9.38	10.91	16.00	27.96	28.00	18.00	22.62	11.98	15.06	16.86	16.05	16.27	13.49	12.37

	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941*	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954
Jan.	$12.50	$16.38	$12.75	$10.27	$ 7.50	$ 5.25	$10.50	$11.60	$13.37	$17.81	$13.00	$13.87	$16.38	$20.00	$18.75	$18.75	$18.75	$29.75	$39.50	$40.00	$26.70	$44.63	$41.50	$41.50	$25.13
Feb.	12.88	16.88	13.31	10.88	7.25	5.25	11.00	11.25	14.19	19.25	12.69	13.94	16.75	19.25	18.75	18.75	18.75	31.63	38.12	35.63	27.50	43.82	41.50	42.50	25.50
Mar.	12.63	16.88	13.19	10.00	7.25	5.25	12.13	10.88	14.75	20.00	12.16	14.25	16.88	19.88	18.75	18.75	18.75	36.69	36.88	33.70	28.25	42.50	41.50	43.50	24.50
Apr.	12.63	15.88	13.00	9.01	7.14	6.00	11.75	9.88	14.34	20.88	11.37	13.37	15.33	18.88	18.75	18.75	18.75	33.06	38.18	23.63	28.75	42.50	41.50	39.88	26.13
May	12.95	15.38	12.50	8.88	6.48	6.45	11.05	10.06	12.87	17.12	11.00	12.75	17.00	18.75	18.75	18.75	18.75	28.38	38.25	23.00	33.75	42.50	41.50	38.25	30.38
June	12.63	14.94	12.00	8.75	5.80	8.91	9.75	9.97	12.86	15.70	10.46	13.46	16.19	18.75	18.75	18.75	18.75	30.88	38.25	20.85	38.75	42.50	40.75	39.38	31.40
July	12.38	14.75	12.00	8.75	4.88	10.42	9.55	10.35	13.37	17.62	12.00	13.50	17.35	18.75	18.75	18.75	18.75	36.97	40.81	19.75	37.25	42.50	39.38	43.38	28.88
Aug.	12.75	15.06	12.13	8.38	5.75	10.48	9.19	12.38	15.19	19.70	13.75	13.87	18.63	18.75	18.75	18.75	18.75	38.88	41.75	22.00	39.16	42.50	41.50	42.25	29.88
Sept.	12.94	15.13	12.50	8.20	6.25	9.84	8.50	12.50	16.15	17.56	13.50	16.22	19.22	18.75	18.69	18.75	18.75	38.75	41.75	28.38	39.81	42.50	41.50	34.40	30.00
Oct.	13.96	14.38	11.38	8.00	6.00	9.47	8.75	12.50	16.25	14.69	12.88	19.16	18.75	18.75	18.90	18.75	18.75	40.88	41.75	28.50	39.75	42.50	41.50	31.00	33.75
Nov.	14.50	13.16	10.13	8.00	5.93	8.60	9.25	13.00	16.50	12.50	14.38	17.85	20.08	18.75	17.00	18.75	23.13	39.13	41.75	30.38	39.75	41.90	41.50	33.88	33.38
Dec.	14.50	12.90	10.00	7.90	5.25	8.94	10.50	13.25	17.00	12.38	13.75	18.67	20.60	18.75	18.80	18.75	27.25	38.90	41.75	28.75	43.44	41.50	41.50	31.00	33.00
Avg.	13.08	14.84	12.08	8.91	6.25	8.97	10.16	11.48	14.74	17.12	12.58	14.91	17.73	19.01	18.27	18.75	19.87	35.45	40.40	27.29	35.32	42.75	41.25	38.24	29.71

* Price unchanged at $18.75 throughout 1942 and 1943.

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Abstracts from past issues of THE IRON AGE, *selected for their flavor, and with some regard for whimsy:*

Shop Belts, Shafts Countershafts Are Gone

If the older engineers could turn time back to the days when they entered the profession, and could draw a picture of the conventional machine shop, we would see at first glance a mass of transmissions through the full length of the shop with belts to countershafts and more belts from the countershafts to individual machines. We would see a large number of machine tools generally grouped as to types and in appearance slightly different from each other, but even as to types and sizes there would not be a great variety to be observed.

Such old friends as the planer and shaper, the engine lathe, the drill press and radial drill, the knee-and-column type milling machine and the Lincoln-type miller, a few universal grinding machines and some tool grinders, were the normal equipment in those days. Instead of the grinding machines, we would observe a few speed lathes and for the production of gears milling machines with index heads, or some primitive gear cutting equipment. Operating these machines, were, almost exclusively, trained mechanics capable of operating any machine in the shop.

July 11, 1935

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1	1000	G.E.	MCF	600	350/700
1	940	Whse.	QM	250	140/170
1	800	Whse.		250	450/550
1	600	Al. Ch.		250	400/800
1	500	Whse.	CC-216	600	300/900
1	500	G.E.	MCF	250	300/900
8	450	Whse.		550	415
1	350	Whse.		230	340/900
1	250	G.E.	MPC	230	400/600
1	300	Rel.	1979T	230	720
8	200	G.E.	CD-1650Z	230	500/1500
1	200	Whse.	CB-5113	250	400/800
1	150	G.E.		600	250/750
1	150	Cr. Wh.	65H	230	1150
8	150	Cr. Wh.	83H-TEFC	230	890
1	150	Whse.	SK-151B	230	900/1800
1	150	Whse.	SK-201	230	360/950
1	125	G.E.	MDS-416	230	415

M-G Sets—3 Ph. 60 Cy.

Qu.	K.W.	Make	RPM	D.C. Volts	A.C. Volts
2	2000/2400	G.E.	450	250/300	2300/4600
1	1750/2100	G.E.	514	250/300	2300/4600
1	2000	G.E.	580	25cy 600	11000
1	2000	G.E.	514	600	6600/13200
1	2000	G.E.	450	600	2300/4600
1	1500	G.E.	720	600	6600/13200
1	1500	C.W.	514	30/115	6600/13000
2	1000	G.E.	720	600	2300/4600
2	750	G.E.	720	275	2300/4600
1	750	C.W.	514	30/115	2300
1	600	G.E.	720	250	440/2300

TRANSFORMERS

Qu.	KVA	Make	Type	Ph.	Voltages
2	4200	G.E. Furn	FOWT	3	13550x55/220
1	3000	Wagner	HPW-20	3	26400x2400
3	2000	G.E.	HVDDJ	1	66000x13800
3	1000	G.E.	HVDDJ	1	2400x480
6	1000	Wagner	OISC	1	13200x460
3	667	G.E.	HD	1	13800x2300

A. C. MOTORS
3 phase—60 cycle

SLIP RING

Qu.	H.P.	Make	Type	Volts	Speed
1	1500	G.E.	MT-498	2300	360
1	1500	ABB		2300	720
2	1000	A.C.	Mill	2300	240
1	800	G.E.	MT	2300	293
1	700	A.C.		2300	500
1	500	G.E.	M-574Y	4000	900
1	500	G.E.	MT-413	2300	580
1	500	Whse.	CW	550	250
1	400	Whse.	CW-960A	440	1170
1	400	Whse.	CW	440	514
1	400	Whse.	CW-1213	2300	435
1	350	G.E.	MT-442Y	2300/4000	253
2	250	G.E.	IM-17A	440/2200	720
1	250	G.E.	MT-424Y	4000	257
1	250	G.E.	MT-559S	2300	1800
1	250	Al. Ch.		550	600
1	200	Cr. Wh.	26QB	440	505
1	200	G.E.	IM	440	435
1	150(unused)	Whse.	CW	2300	435

SQUIRREL CAGE

2	650	G.E.	FT-559BY	440	3570
1	500	G.E.	K-6345-8	2300	1185
2	450	Whse.	CS-1429	2300/4150	854
1	450	G.E.	IE-15B	2300	1145
1	400	G.E.	IK	2300	500
1	200	G.E.	IK-17	440	580
3	200	G.E.	KT-557	440	1800

SYNCHRONOUS

1	4250	C.W.	2581-8L	13800/2300	514
2	2100	G.E.	ATI	2300	360
3	2000	Whse.		2300	120
2	1750	G.E.	ATI	2300	3600
2	725	G.E.	ATI	2300/12000	600
1	500	Ideal	SM	2300/4160	1800
2	500	G.E.	TS-7507	2300	1200
1	450	Whse.		2300	128
1	450	Whse.		2300	450
1	400	G.E.	TS-7565	2300	1200
1	400	G.E.	TS	2300	400

COMBINATION—MILL DRIVES
M.G. and D.C. Motor
600 V. D.C.—3 ph. 60 cy. A.C.

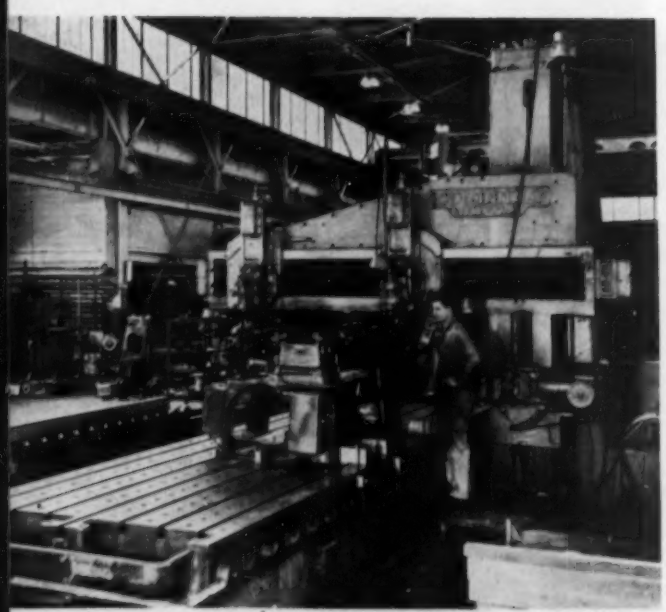
1—2500	HP.	Whse.	600 RPM
2800	KW.	G.E.	2300/4600 V.
1—2200	HP.	G.E.	400/500 RPM
2000	KW.	G.E.	2300/4600 V.
1—1400	HP.	G.E.	65/190 RPM (Rev.)
1500	KW.	G.E.	6600/13200 V.
1—1250	HP.	Whse.	600 RPM
1000	KW.	G.E.	2300/4600 V.
1—1250	HP.	G.E.	750/900 RPM
1000	KW.	G.E.	2300/4600 V.
1—1000	HP.	G.E.	350/700 RPM
1000	KW.	G.E.	2300/4600 V.
1— 500	HP.	Whse.	340/900 RPM
500	KW.	Whse.	2300 V.
2— 450	HP.	Whse.	415 RPM
400	KW.	Whse.	2300 V.

BELYEA COMPANY, INC.
47 Howell Street, Jersey City 6, N. J.



R. A. Vine, Inc.

REBUILT AND RECONDITIONED MACHINERY



Motch & Merryweather Machinery Co.

PLANER of size 72 in. x 72 in. x 20 in. handles machining of large machine tool bases.

FOR COUNTLESS THOUSANDS of small metalworking shops, reconditioned and rebuilt machinery has provided a beginning; for other manufacturers who have bought used machine tools to upgrade equipment, it has been a means to more efficient operations and to increased production. For the country, the used machine tool industry has been vital in its defense and an essential factor in its development and growth as an industrial power.

The used machine tool industry had its beginning in the 1880's. In these early days, the dealer's activities were largely those of a broker and though he handled a hodge-podge of industrial equipment, his knowledge of machinery was small. Because machinery was comparatively scarce, the dealer bought almost any machine offered for sale and sold it in "as is" condition, letting the customer decide if it was suited to his purposes.

Around the turn of the century, as lumber became less important to manufacturing, the dealer began to confine himself to metalworking equipment. This was the era of steam powered, belt driven machinery and the dealer's

inventory included shafting, pulleys, belting, steam engines, boilers and pumps.

About this time, too, the used machinery dealer became more than a broker. He expanded his business to include its technical aspects and began rebuilding and reconditioning machinery. This following quotation from a 1918 copy of the *Seattle Daily Bulletin* indicates just how much progress dealers had made in this area by the end of World War I.

"The larger dealers in second-hand machinery have splendidly equipped shops for overhauling and rebuilding; they have a thorough knowledge of mechanics, they know exactly what a certain piece of machinery will do; they give a guarantee that is as good as their bond and they are held in high esteem by the buying trade."

It was during the first World War that the used machinery business came of age. Several years before war broke out, manufacturers had released large quantities of machinery due to poor business conditions in certain industrial lines. Dealers risked their capital in most of this surplus in the hope of a long range increment.

When war came, increased production demands quickly exhausted existing supplies of new machinery. Rather than hazard time and production losses, rebuilt and reconditioned machinery was called upon by the manufacturer to fill gaps in American factories and in those of our allies. For the estimated 250 used machinery dealers in 1918, business boomed—used industrial equipment amounting to about $500 million was sold in this country alone between 1916 and 1918.

During the early '20's, the heavy flow of war



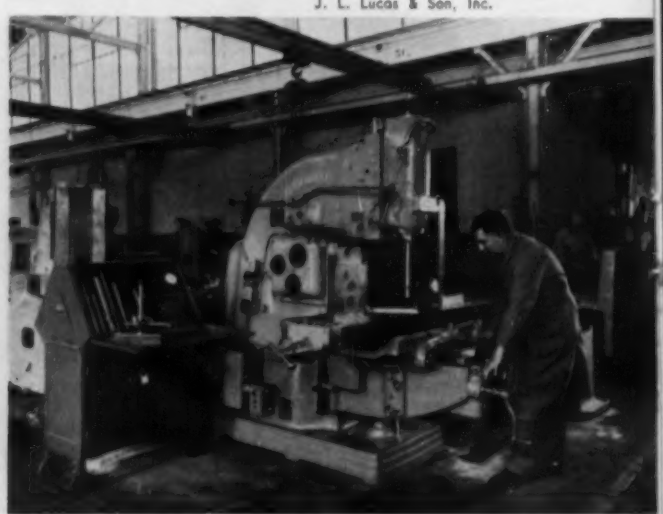
Motch & Merryweather Machinery Co.

Right: **BAY at rebuilders plant shows a group of machine tools for reconditioning or rebuilding.**

J. L. Lucas & Son, Inc.



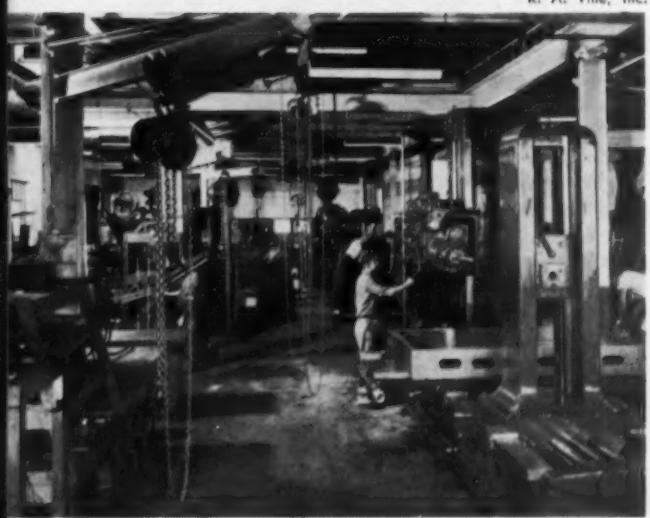
J. L. Lucas & Son, Inc.



◀

Left: **COMPONENTS of 16 in., 8-spindle automatic lathe thoroughly disassembled for rebuilding.**

R. A. Vine, Inc.



◀

Far left: **CHECKING parts from stripped milling machine, left, to determine which need replacement.**

◀

Left: **ACCURACY test being conducted on milling machine which has been completely rebuilt.**

surplus machinery sustained sharp wartime increases—the rebuilt and reconditioned machinery business thrived and grew.

Beginning about 1916 and continuing until the outbreak of World War II, gradual changes in machine tool design profoundly affected the dealer's machine tool inventories. Gasoline engines replaced steam engines. Electrically powered, belt driven equipment followed and this later led to more efficient electric and hydraulic machinery. With the advent of this newest development, gear mechanisms, motor drives, shafting and belting began to disappear from the dealer's warehouse and show rooms. As speeds increased and horsepowers mounted, machinery became heavier, making additional handling equipment necessary to the dealer's shop operations.

Machine tool design changes together with generally healthy business conditions stimulated the purchase of used machinery throughout the late '20's.

1929, however, hit hard. During the early '30's almost any price would move a machine and though business continued to pick up some after '33, full recovery did not begin to approach until 1937.

In 1937 the prospect of war hung over Europe and the British and French, in desperate need of machinery to start war production, bought large quantities of rebuilt and reconditioned machine tools in the United States. By December 1941 when Pearl Harbor was attacked, stocks of late model used tools had been heavily depleted; new machinery inventories were short and production schedules were not great enough to meet the emergency; the realization of full mobilization requirement was several years away.

In the crisis, the government asked the used machinery dealer for help—the dealer's job: to find all existing machinery that could possibly be put into war production and to rebuild this machinery where necessary for the nation's assembly lines.

The dealer was well-suited to this task. His day to day business depended not only on his mechanical knowledge of machinery, but also on his ability to locate it and make it immediately available.

The supply readily available to the dealer, however, was not enough to satisfy the nation's hunger for machine tools. In the stress of emergency, used machinery dealers searched in out of the way places and in neglected warehouses the country over where they knew there were forgotten machine tools capable of helping fight the war.

In factory attics and in boarded up recesses, in abandoned warehouses surrounded by wheat fields and in barnyard tool sheds, they found hundreds of machine tools that after reconditioning, contributed significantly to the coun-

try's defense by establishing production lines and filling gaps until delivery could be made on new tools.

During the war, used machine tools like all other essential commodities were government regulated. To help government agencies set up workable price and allocation controls and to insure cooperation between the government and the industry at a time of national emergency, the dealers established the Machinery Dealers National Association in April of 1941.

Shortly after MDNA was organized, a committeee of the country's formost machine tool rebuilders began work on a set of standards for rebuilding machinery. It was MDNA's hope that through its formal adoption of such a code, uniformly high rebuilding practices would spread throughout the industry. Though formal adoption of the standards is still in the future, this guide to rebuilding is widely accepted and used by both government and industry and is generally preferred to the Schlesinger rebuilding formula.

In 1952, after much study and consideration, MDNA formally established another policy designed to help its members better serve the buyers of used machinery. Under the association's sponsorship, members adopted a code of ethics that assures customers of fair dealings and sound business practices.

When Korea erupted, both the government and the dealer were better prepared than in the previous emergency. World War II surpluses of good, late model machines had not yet been fully depleted and from these stocks, defense needs were partly met. In addition to defense spending, orders from civilian goods manufacturers, deprived of new machine tools by government priorities, expanded the dealer's business.

After the Korean crisis, a logical plan for return to civilian production was developed through the cooperative efforts of the Office of Defense Mobilization, MDNA and others interested in the disposal of government owned machine tools. As a part of ODM's program, teams of government representatives, machine tool builders and machinery dealers inspected large quantities of government surpluses. On the basis of these inspections, some of the tools were sold, some were scrapped and others were slated to be rebuilt for the government's emergency reserve.

In technical skill, in rebuilding and reconditon facilities, in knowledge of markets and of customer requirements and in wide acceptance by manufacturers and government, the used machine tool industry is stronger today than ever before. Though the industry has suffered steady declines since 1952, the future is optimistic. Better values in reconditioned and rebuilt machinery, healthier domestic and foreign markets and an expected surge in government machine tool purchasing programs point to an upward business swing. Dealers also feel that if the decision of next year's Congress is to include used machinery in the accelerated tax-depreciation schedule, sales will increase.

Within the next decade, industry will continue the conversion to automation and higher powered machinery, displacing large quantities of tools now in use or now being built. The effect of this on the used machine tool business cannot now be fully predicted. But, judging from past experience in times of machinery changeovers, and because more good surplus machinery will be available at better prices, business opportunities at this time for both the dealer and the user should be plentiful.

For three-fourths of a century, used machinery has been a significant factor in industry. It promises to be a still great factor.

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1—27" x 90" SCALE BREAKER.

1—24" BAR MILL, 3 STANDS, WITH MOTOR, SPEED REDUCER, TRAVELING TILTING TABLES, BILLET FURNACE, TABLES AND SHEAR.

1—18" BAR MILL, 3-HIGH, 1-STAND.

—10" BAR AND ROD MILL STANDS, 2-HIGH.

1—12" x 16" HOT STRIP MILL, 2-HIGH, 12 STANDS.

1—29" & 15" x 48" SHEET ROUGHING MILL, 3-HIGH, WITH TABLES.

1—28" 2-HIGH PINION STAND, 6'6" SHOE PLATE SPREAD.

1—4-HIGH COLD MILL FOR 38" WIDE STRIP.

1—10" x 16" 3-STAND TANDEM COLD MILL.



Model "C" Billeteer

GEAR REDUCTION SETS

1—2000 HP, RATIO 10 TO 1.

1—1500 HP, RATIO 237 TO 55 RPM.

1—700 HP, RATIO 390 TO 25, 50 & 75 RPM (3 OUTPUT SPEEDS).

1—500 HP, RATIO 16.85 TO 1, WITH 2-HIGH PINION STAND.

1—320 HP, RATIO 800 TO 107 RPM.

CRANES

1—125-TON LADLE CRANE, 50' SPAN, SPAN, 10-TON AUXILIARY.

1—50-TON NORTHERN CRANE, 52'9" SPAN, 10-TON AUXILIARY.

FURNACES

2—PACK FURNACES FOR HOT SHEET MILLS, 62" x 60', DOUBLE CHAMBER, CONTINUOUS.

3—13' x 57' SLAB FURNACES FOR HOT STRIP MILL.

1—ELECTRIC MELTING FURNACE, 6-TONS CAPACITY, SIDE CHARGE.

—ANNEALING FURNACES FOR SHEETS, COILS AND BARS.

SHEARS

1—FLYING SHEAR FOR UP TO 4" SQUARE, 600 FT. PER MIN.

1—FLYING SHEAR FOR 7/8" SQUARE OR ROUND.

1—PLATE SHEAR, CAPACITY 156" X 1".

1—PLATE SHEAR, CAPACITY 48" x 1 1/8".

1—SHEET SHEAR, CAPACITY 144" x 3/8".

1—VERTICAL OPEN SIDE BAR SHEAR, CAPACITY 3 1/2" SQUARE.

1—AUTOMATIC SIDE AND END CUT SHEAR LINE FOR SHEETS, 155" x 55" x 3/16".

MOTORS

1—3500 HP, 240 RPM, 6600/3/60.

1—1500 HP, 443 RPM, 6600/3/60.

1—700 HP, 390 RPM, 2200/3/60.

2—600 HP, 300/600 RPM, 600 VOLTS D.C.

1—400 HP, 514 RPM, 440/3/60.

MISCELLANEOUS

3—BONNOT-LENTZ BILLETEERS FOR CONDITIONING BILLETS, MODELS A, B & C, RANGE 2" TO 13" SQUARE.

1—COKE PUSHER COMPLETE WITH MOTORS AND CONTROLS, LITTLE USED. BUILT BY KOPPERS CO. IN 1951.

1—CORRUGATING MACHINE FOR SHEETS, INCLUDING 2 SETS OF DIES, 1 1/4" AND 2 1/2".

1—DRAWBENCH, 50,000 POUND, EQUIPPED FOR TUBES. 150 HP MOTOR.

1—DRAWBENCH, 30,000 POUND, 60' DRAW, 120 HP MOTOR.

1—GRINDER FOR ROLLS, SIZE 34" x 192".

1—PICKLING MACHINE FOR SHEETS, AETNA-STANDARD, TAYLOR DESIGN, WITH ROCKER ARMS.

1—ROLLER LEVELLER, BACKED-UP, CAPACITY 22 TO 13 GAUGE SHEETS, 76" MAXIMUM WIDTH.

1—STRAIGHTENER, SUTTON NO. 2, 5 ROLLS, CAPACITY 3 1/2" DIA.

1—STRAIGHTENER, TAYLOR-WILSON NO. 2, CAPACITY 1/4" TO 1 1/2" DIA.

1—ROLL LATHE, CAPACITY 44". ENCLOSED HEADSTOCK. VARIABLE SPEED DRIVE.

1—STRETCHER LEVELLER, CAPACITY SHEETS 60" WIDE x 150" LONG.

1—SCRAP BALER, BOX SIZE 84" x 18" x 36".

4—TINNING MACHINES FOR HOT DIP TIN PLATE.

6—TABLES FOR 2-HIGH HOT SHEET MILLS.



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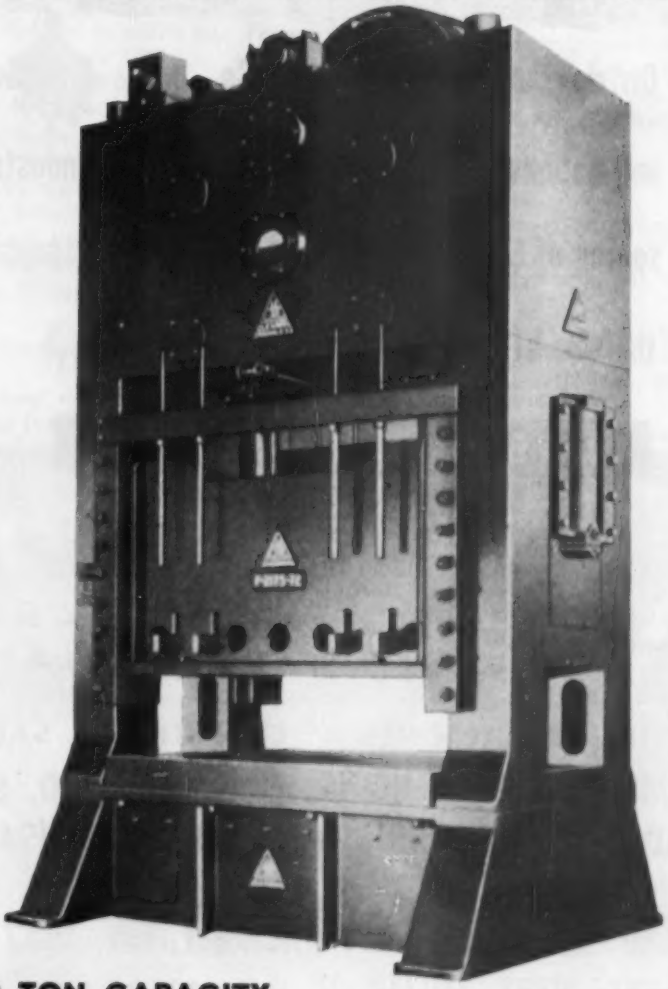
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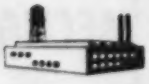


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DRILL, 6' 15" AMERICAN MAXI SPEED
LATHE, 48" x 24' c.c. NEBEL, 1947
LATHE, 36" x 15' c.c. Lodge & Shipley, PRT.
LATHE, 22" x 78" Lehmann Hydratrol, '42
MILLER, #5HP. CINN., 96" table, 1939
MILLER, #3K K & T, Plain, 1500 RPM
TURRET, #5 Gisholt, presel., '41
TURRET, #2 Warner & Swasey, bar, '48
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24½" x 28' Monarch Engine Lathe, 2 Carriages, 2 Taper Attachs., Rap. Trav., Ser. #6806, New 1940

#22B Bardons & Oliver Saddle Type Turret Lathe, 4½" Hyd. Bar Feed, Hyd. Pre-Selector Head, Ser. #17013, New 1947

#4 Cinn. Dial Type Univ. Mill, Ser. #4A4U1H-3, New 1940

5-48 Cinn. Plain Hydromatic Mill, Ser. #3B51PA-5, New 1953

36" Rockford Hydraulic Vert. Slotter, Ser. #47-S1-85, New 1946

#4 Cinn. Hi-Speed Dial Type Vertical Mill, Ser. #8A4V1K-35, New 1941

#4 Cinn. Hi-Speed Dial Type Plain Mill, Ser. #4A4P1L-132, New 1942

16-44 Cinn. Vert. Hydrotel w/Hyd. Duplicating Attach., Ser. #51M788824-8, New 1951

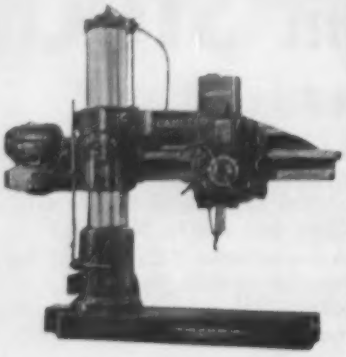
These and *hundreds* of other late type machine tools are offered for *sale* or *rent*.



A Keyhole View of One of Our Three Bays of Late Type Machinery

EMERMAN MACHINERY CORP.

865 WEST 120th STREET **Telephone: PUllman 5-7626** **CHICAGO 43, ILLINOIS**



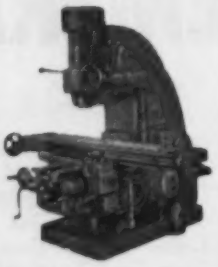
6'-19" column CARLTON Low Hung Drive Ball Bearing Radial Drill, 15 HP 3/60/220/440 volt AC motor on arm.

BRAND NEW—LARGE DISCOUNT STILL IN FACTORY WRAPPINGS

4'-9" column CINCINNATI BICKFORD Super Service Radial Drills, No. 4 Morse taper, 9 speeds 75 to 1500 RPM, 4 power feeds, 3 HP motor on arm, automatic tapping reverse, coolant system.

DRILLS & RADIALS:

21" CINCINNATI BICKFORD Super Service Box Column Drill, direct drive, 3HP motor, power feed, tapping, new 1950
24" CINCINNATI BICKFORD Super Service Box Column Drill, 12 speeds, 9 feeds, tapping, 5HP motor, new 1943
4'-12" FOSDICK Sensitive Radial Drill, new 1951, speeds 150 to 3000 RPM, 3HP motor on head
3'-13" CARLTON, 7½HP 3/60/220/440 volt motor on arm, 48 speeds 15 to 1500 RPM
4'-16" CARLTON Radial Drill, 10HP 3/60/220/440 volt motor on arm, 48 speeds 15 to 1500 RPM
6'-15" FOSDICK Economax Radial Drill, 10HP 3/60/220/440 volt motor on arm, 36 speeds 14 to 1000 RPM
6'-17" CINCINNATI BICKFORD Super Service Radial Drill, 10HP 3/60/220/440 volt motor on arm, rapid traverse, electric column clamp
6'-19" CARLTON Radial Drill, 15HP 3/60/220/440 volt motor on arm, 36 speeds 15 to 1500 RPM, column clamp and rapid traverse



No. 4CH KEARNEY & TRECKER Vertical Mill, New 1951. Table 74" x 15½", 24 speeds 15-1500 RPM, No. 50 taper, mono-lever & automatic cycle table control, backlash eliminator, 10HP spindle motor, 3HP feed & rapid traverse motor, ¼ HP coolant motor.

MILLING MACHINES:

No. 2 BROWN & SHARPE Light Type Vertical, swivel head, new 1943
No. 2MI CINCINNATI Vertical, speeds 25 to 1500 RPM, No. 50 taper, new 1951
No. 2 VAN NORMAN Plain Horizontal, speeds 25 to 1250 RPM, No. 50 taper, new 1943
No. 3 CINCINNATI Dial Type Plain Horizontal, speeds 18 to 450 RPM, vertical head, new 1941
No. 3 CINCINNATI High Speed Dial Type Vertical, speeds 18 to 1300 RPM, new 1951
No. 4 CINCINNATI High Speed Dial Type Vertical, speeds 18 to 1300 RPM, new 1951
No. 4CH KEARNEY & TRECKER Vertical, mono-lever control, latest type, new 1951
No. 6 REED PRENTICE Vertical, table 84" x 20", 72" table travel, 24" cross travel, 28" under spindle, speeds 15 to 1500 RPM, 10HP 3/60/220/440 motor, No. 50 taper, new 1941

BORING MILLS:

42" BULLARD Vertical Turret Lathes, Serials 23441 and 23108, both new 1944, 2' extra high column, spiral drive type, 25HP 3/60/220/440 volt motor & controls, rebuilt (2)
6" bar NILES Horizontal Boring Mill, Floor Type, enclosed head, 6' vertical travel, 35HP motor

Many Other Good Buys in Late Model Grinders, Lathes, Shapers Boring Mills. *Write for stock list.*

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1693 GENESEE STREET **BUFFALO 11, N. Y., Tel.: BAiley 5800**

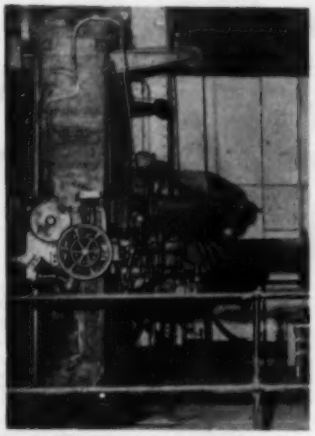
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HEAVY UNUSUAL MACHINES



BORING MILLS, HORIZONTAL

5" Sellers Drilling & Bor. Fl. Type (Post Mill), Motor on Head Univ. Base

No. 399 Giddings & Lewis, 4" Bar, Floor Type, MD w/Univ. Rotary & Tilting Table

No. 31 Lucas, 3" Bar, Motor Drive

BORING MILLS, VERTICAL

36 ft Niles, 2 Swivel Heads, D.C. Motor Drive

42" King, 2 Swivel Heads, Motor Drive

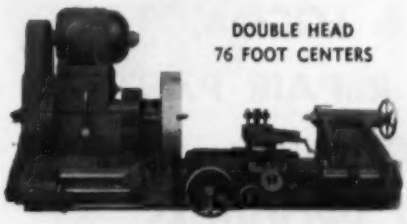
GRINDERS—TOOL & CUTTER

No. 1 Heald Diamond Tool Sharpener

HONING MACHINES

H-2—Hydrohoner-Micro. Refrig. Equip.

LATHES—ENGINE



48" x 85 ft Niles Bement Pond Double Head Engine Lathe with 2 Anti-friction Heads and 2 Tail Stocks

(76 ft C-C with One Head Removed)

2 Complete Lathes on One Bed: 2 Carriages with Power Rapid Reverse; 4 Steady Rests; Arranged to Receive Center Lead Screw for Boring Operations.

48" x 56 ft Niles Bement Pond MD, P.R. Trav. Anti-friction Head

48" x 29 ft Niles Bement Pond MD, P.R. Trav. Anti-friction Head

27" x 24 ft C.C. Lodge & Shipley Grd, Hd. M.D.

24" x 88" C.C. Boye & Emmes, Timken Head

20" x 10 ft Bed American Grd, Hd. T. Attach.

LATHES, TURRET

No. 1A Warner & Swasey, Taper & Thread Chasing Attach.

PLANERS, DOUBLE HOUSING



60" x 60" x 14 ft Pond, Box Table, Reversing MD

48" x 48" x 16 ft Niles, Box Table, Reversing MD

PLANERS, OPENSIDE

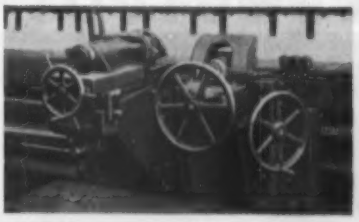


60" x 60" x 18 ft Bethlehem (D&H), Box Table, P.R.T., Forced Feed Lub., Rev. MD

BRAKE

750 Ton Wood Hydraulic Press Brake or Keel Bending Machine. With Pumps & Operating Equipment. Capacity, 25 Feet of 1" at Right Angle 25 Feet of 1½" on 5' Radii.

PLANERS, PLATE EDGE



30 ft x 2" Sellers Heavy Duty Plate Planer, w/Plain & Scarfing Heads M.D.

32 ft x 1" Sellers Model B, Plate Planer, Adj. Carriage, MD

36 ft x 4½"Hilles & Jones, Plate Edge, Milling Machine w/MD Milling Head

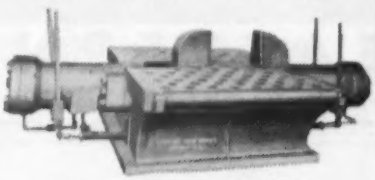
SHAPERS

36" American Universal Back Geared Shaper, V-Ram, MD

SHEARS, ROTARY

No. 60 Quickwork Rotary Shear, 48" Throat, Indicating Signal. Mo. Dr.

10 Foot x ⅜ #6½ H & Jones Plate Shear



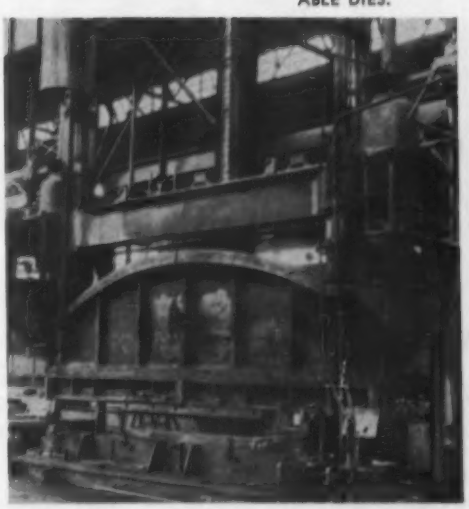
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37 Ton Camden Iron Works Double Cyl. Hyd. Bending & Straightening Machine



32 ft x 1" Bement-Miles, Ship Plate Type Rolls, Top Roll Shifts; Pinching in both Directions

USED AS A HYD. BRAKE: — CAPACITY 32 FOOT of ¾" PLATE USING SUITABLE DIES.



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GISHOLT No. 12 Hydraulic Antomatic Lathe with air operated tailstock.

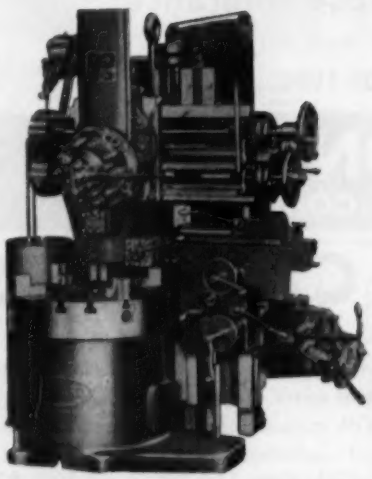
30 MACHINES IN STOCK

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RENTAL
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CINCINNATI No. 3 Dial Type; High Speed Miller, Timken Bearing; latest type; New 1953



Ask for Catalog of AMERICA'S LARGEST STOCK



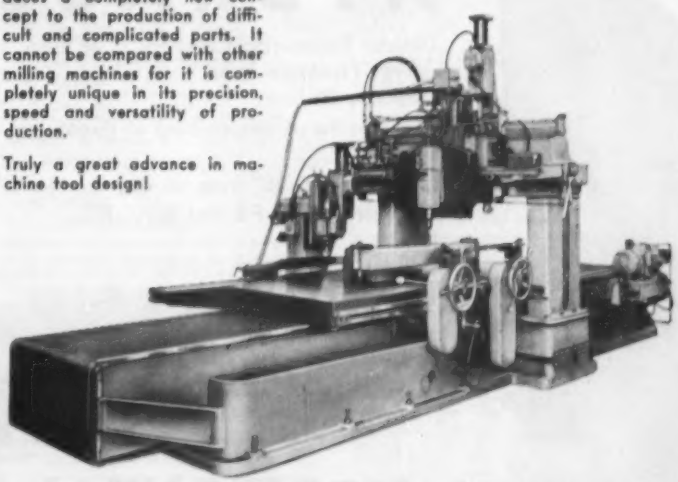
BULLARD 24" Vertical Turret Lathe.

Completely Revolutionizes the Milling of INTRICATE AIRCRAFT PARTS!

MOREY No. 50M Vertical "Aeroframe" Profiler and Milling Machine

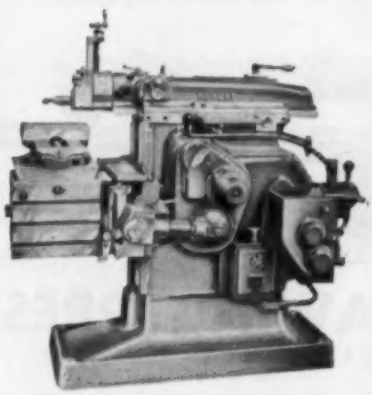
This amazing machine introduces a completely new concept to the production of difficult and complicated parts. It cannot be compared with other milling machines for it is completely unique in its precision, speed and versatility of production.

Truly a great advance in machine tool design!



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HENDEY 12" Crank Shaper.

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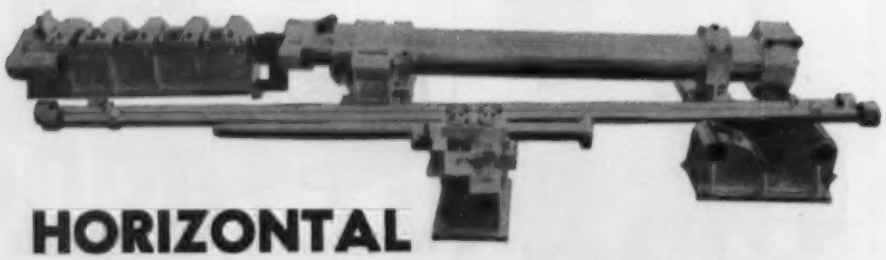
HYDRAULIC PRESS

Denison Engineering Company C or Gap Type Hydraulic Press
Capacity 50 tons
13¾" center of ram to back of throat
Stroke, 12"
Closed height, 25" (ram all way down)
Table size, 19¾" F-B and 20½" R-L
Ram size, 8"

Double acting ram
Average thickness of steel in frame, 1⅛"
Floor space, 57½" x 42" x 9'6" high
With manual control valve and gauge
Self contained Vickers Pump; Model V 2324; Cap. 13.4 G.P.M. @ 2000 P.S.I.
U. S. Motor; 15 H.P. 3/60/220/440; 1200 R.P.M. with starting equipment.

HIGH PRESSURE AIR FLASKS

2—36" x 10 Ft. tested to 5000 P.S.I.
2—36" x 12 Ft. tested to 5000 P.S.I.
3—20¼" x 36 Ft. tested to 5500 P.S.I.
2—21¼" x 48 Ft. tested to 5500 P.S.I.



HORIZONTAL HYDRAULIC DRAWING PRESS

UNITED ENGINEERING CO.

275 Ton capacity; ram diameter, 18¾"; stroke, 15'6", working pressure, 2500 psi; horizontal, two column; 48" clear between cols.; col. diam. 7"; overall length, 52'6"; approx. wt. 90,000 lbs.; complete with five draw rings, mandrel, and R. D. Wood operating valve. 1944.

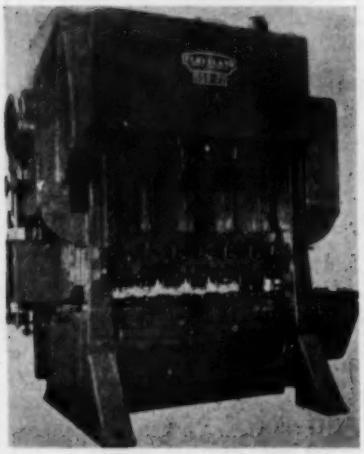
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POWER PRESSES



TRANSFER PRESS

CLEVELAND No. 55-D-72, Six Station Transfer Press, Air Cushion on first station, Stroke of slide 8", Shut height 20" Bed area overall 80"x48", Distance between stations 12", Diameter of Crank-Pin 7½".

DOUBLE CRANK

BLISS No. 7, 200 ton, Bed 28"x54"
NIAGARA No. 69BX, 125 t., bed 42"x36", str. 4", M.D.
CLEVELAND 65G72 Gap Frame, Bed 96"x24", 150 ton
FERRACUTE 9G, 106, Bed 42"x84", RL, 100 Ton
CLEVELAND 45-D-60, 60"x40" bed, 3½" stroke

STRAIGHT SIDED SINGLE CRANK PRESSES

BLISS NOS. 37½, 52, 74½, 75½, 76½, 77½, 79½, 300, 304, 305, 307, 500W, GEARED & FLYWHEEL WITH AIR CUSHIONS. SOME W/SIDE SHEARS FOR FORGE WORK.

MINISTER 40-5½
FERRACUTE E-3 & E-4 with Roll Feeds
FERRACUTE DG-53 & DG-54 Geared
FERRACUTE DGG-56-25" stroke Deep Draw Press
NIAGARA No. 510 Geared with Side Shear
TOLEDO No. 50¾, Twin Flywheel Forging, 400 Ton

BLISS NO. 88, 250 TON CAPACITY, 18" STROKE, AIR CLUTCH, AIR CUSHION

GAP FRAME AND BACK WHEEL

3—TOLEDO No. 77A GAP FRAME-GEARED, BED 30"x36", 12" STROKE.

BLISS No. 31, 58, 61 & 62, M.D.
BLISS-STILES No. 2, 3, 4 & 5, No. 2C & 3C
FERRACUTE P-1, P-2, P-3, P-4, P-5, & PG-5, M.D.
TOLEDO Nos. 15 & 17 Deep Throat

POWER PRESSES

DOUBLE ACTION—CUT & DRAW

ADRIANCE Nos. 44, 45 & 46 Strip & Roll Feed
ADRIANCE 16 Die Crown Cap Press
BAIRD No. 2 & 3 Tandem Roll Feed Transfer
BLISS No. 1, 1½B, 3½, 5 & 6 Cam & Crank
WATERBURY-FARREL Nos. 1, 2, 2½, Feeds
BLISS Nos. 68N and 68N O.B.I.
BLISS No. 822 Strip Feed Presses

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VERSON 800 ton, Air Clutch, 4" Stroke, Like new
CLEARING K1750-30, 200 ton cap. Enclosed gearing. 4" Stroke, Air Clutch
TOLEDO Nos. 660, 662, 663A, 9½" Stroke, 400 ton cap., Air Clutch
BLISS Nos. 4, 22K, 24K
FERRACUTE No. E51, 75 ton, EG 54, 400 ton
FERRACUTE E251, Down Ram M.D., Now 1944
WATERBURY 25, 50 and 320 ton
ZEH & HAHNEMANN Nos. 7, 8½, 10 & 12 Perc.

WILLIAMS & WHITE 29U BULLDOZER

POWER PRESSES

TOGGLE DRAW PRESSES

FERRACUTE 8D-700 DOUBLE ACTION TOGGLE DRAW PRESS, 700 TON CAP. BED AREA 60" F.B.x72" L.R.: STROKE OF PLUNGER 40", STROKE OF BLANKHOLDER 20", 100 H.P. MOTOR

BLISS Nos. 1½, 1½B, 3½A, 3½B, 3½C, 3¾
GARRISON, 500 Ton 12" shaft, 48x84 bed, single crank

INCLINABLE (O.B.I.)

BLISS Nos. 18, 19, 19C, 20, 20B, 21, 21½, 23 & 25
FERRACUTE C2, C3, C4, C5
V & O Nos. 00, 0, 01, 1, 2, 4, 101, 102, 103 & 104, Flywheel & Geared, with Dial & Roll Feeds
NIAGARA A1¼, A2, A3, A3½, A4, A6½



NIAGARA A6½ O.B.I., 190 ton Cap., 10" stroke, Air cushion. Like new condition.

HORNING & WIRING

ADRIANCE, CALLAHAN—Nos. 23, 24 & 25
BLISS Nos. 2A, 4A & 5A Adj. Bed
BLISS Nos. 16, 39, 40 & 41 Adj. Tables
FERRACUTE Nos. CA-4 & CAG-4 M.D.
FERRACUTE No. PA-4 & PA-5 End Wheel Type

EYELET & TRANSFER PRESSES

WATERBURY-FARREL No. 57 Cam Type
WATERBURY-FARREL 13 Stations, 11½" Stroke
BLISS No. 353 Dble. Act., 10" Plunger Strk. 5 Sta.
BLISS 5 Station, Tooled for Pie Plates, 100 ton cap.
CLEVELAND 55-D-72, 6 Sta., Excl. gearing, like new
BAIRD No. 4-37, 14 Stations M.D., Roll Feed

HIGH SPEED PRESSES

WATERBURY No. 1 & 3
BLISS No. 550
All have double roll feed

ROLLING MILLS

AJAX 3 HI 3 STAND ROD & BAR MILL FALK SEALED REDUCER, GE 4 SPEED AC MOTOR

McWILLIAMS & RUESCH JEWELERS ROLLS
UNITED ENGINEERING 8"x14" & 8"x10"
WATERBURY FARREL 10" x 10" 50 HP Motor
BLAKE & JOHNSON 12"x16" Motor Screw Down
BLISS 6"x9" anti-friction bearings—2
NEWBOLD 3 High—20"x30"

LEWIS 28"x56" FACE ROLLING MILL, MOTOR DRIVEN, SCREWDOWN, SEALED GEAR REDUCTION DRIVE

BOLT, SCREW, NUT & RIVET EQUIP.

National D.S.S.D. Cold Headers high speed, cap. 5/16" steel, ¼" aluminum, M.D. like new

WATERBURY-FARREL No. 45 cap. ⅝"x8"
WATERBURY No. 6 Solid Die Header, ⅞"x4"
WATERBURY No. 6 D.S.S.D. Reheader Cap. ⅝"x9"
WATERBURY No. 3 Dbl. Str. Open Die 1"x6"
MANSVILLE No. 512C—5/16 Cap. with Ajax Hogue Wire Drawers D.S.S.D.
WATERBURY-FARREL Double Stroke Solid Die No. 2 Quarter Inch Capacity: No. 3½ Half Inch Capacity: No. 5 ⅝" capacity
WATERBURY-FARREL 5/16" Cap. and ½" Cap. Double Stroke. Open Die Cold Headers

WATERBURY-MANVILLE Double & Single Stroke Cold Headers, Capacities 1/16" to ⅝"
ROD HEADERS ½" & ¾" Capacity
WATERBURY Nos. 1 & 2 Auto. Screw Slotters
MANVILLE Auto. Wood Screw Machines
WATERBURY-FARREL Nos. 8, 10, 20, 30 & 50 thread Rollers, Hand and Hopper Feed, M.D.
NATIONAL 3/16", ¼", ⅜", ½" Auto. Bent Shank Nut Tappers (Standard & Precision)

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BAIRD, NILSON, MANVILLE FOUR SLIDES, Nos. 0, 1, 2, 3, 4, 5, 3-20, 4-20, M.D. WIRE AND STRIP FORMERS (NEW AND USED)
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WIRE DRAWING EQUIPMENT

MORGAN 4 BLOCK CONTINUOUS WIRE DRAWING MACHINE (22" BLOCKS)
VAUGHN NOS. 8, 10 & 12 MOTORBLOCKS, M.D.
WATERBURY WIRE DRAWING EQUIP.
BULL BLOCKS, HORIZ. & VERTICAL NOS. 0-7 DIE SLEEVE TYPE FOR ALUM. & COPPER
NOS. 1, 2, & 3 UPRIGHT ROLL—7 DIE

STANDARD, TORRINGTON, LANGELIER, ETNA WIRE & TUBE SWAGERS Nos. 1, 2, 3, 4 & 5
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MACHINERY FOR THE PRODUCTION OF WIRE SPECIALTIES, WIRE STAPLES, HAIR & BOB PINS, PAPER CLIPS, STRAIGHT & SAFETY PINS, NAILS, WIRE BASKETS & WIRE GUARDS

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MESTA 13'x¾" Capacity 50 H.P. M.D.
NIAGARA No. 212S—10'x14 Gauge
CANTON FOUNDRY 11' & 14' ga. Power Shear
PELS HEAVY DUTY BEAM SHEAR, CAPACITY UP TO 12" Beam or Channel at one stroke
BLISS, NIAGARA, QUICKWORK, MARSHALLTON DEEP THROAT & THROATLESS Shears
NIAGARA No. 216B Circle Shear

HALLDEN 24" STRIP STRAIGHTENER & AUTOMATIC CUTOFF M.D.

SLITTERS

YODER 30" GANG SLITTER, complete with uncoiler, rewind, scrap chopper

BLISS Nos. 235, 235A, 235 & 315 Gang
WATERBURY Nos. 0, 1, 2 Gang
YODER 12" wide, like new listing

ROLL LEVELLERS

AMERICAN 17 Roll, 84" face x 9" diameter
W & E 54" Wide x 2½" Face
WATERBURY 16", 9 Roll, 5" diameter
McKAY 18" face x 7" dia. rolls (1941)

ROLL FORMERS

RAFTER 7 Head Tube Former
RAFTER 5 Head Tube Former
PITTSBURGH 4 & 5 Head Tube Formers
MAPLEWOOD Tooled for Curtain Rods
YODER 5 Head with Flying Shear
YODER M1½, 8 Station
YODER M3, 42" wide, 10 Station
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1 YEAR GUARANTEE

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250 VDC MG SETS

KW	Make	Type	Speed
750	G.E.	New	750
250	C.W.	CCD	1200
200	El. Mchy.		900
150	G.E.	MPC	1200
125	El. Dy.		1800
125 (2)	G.E.	MPC	1200
100 (2)	Westg.	SK-163	1200
100 (2)	Delco		1200
75	C.W.	SK-CD	1150

600 VDC MG SETS

KW	Make	Type	Speed
400	G.E.	MPC	720
200	Westg.	SK-163	1200
50	G.E.	BC	1150
30	G.E.	CD-1127Y	1150

125 VDC MG SETS

KW	Make	Type	Speed
200 (2)	Westg.	SK	900
150	Westg.	SK	1200
100	G.E.	BC-17	1200
100	El Mchy.	651-T	1200
100	G.E.	MPC	900
75 (2)	Westg.	SK-36	1200
50	Westg.	SK-153L	1160

LOW VOLTAGE DC MG SETS

Amps	Volts	Make	Speed
3200	60	G.E.	1100
800 (2)	60	Westg.	1100
900	53	Hertner	1150
500	58	G.E.	850
1800 (4)	45	G.E.	900
1500 (5)	40	Century	900
200	35	Westg.	1750
100	32	G.E.	1800
200	22	G.E.	1800
2000 (3)	30	G.E.	720
1000/500	8/16	Bogue	1200
5000/2500	6/12	Chandy	300

230 VOLT DC MOTORS

H.P.	Make	Type	Speed
325 (4)	G.E.	MPC	1160
250	Reliance	2800-T	400/800
250	Cr-Wh.	B.B.	1500
150	G.E.	BC-36	1700
150	Westg.	SK-163	1100
150 (2)	G.E.	BF	400/1200
125	Westg.	SK-173	850
125	Reliance	1050-T	600
100	G.E.	BC-36	950
100 (2)	Westg.	SK-160	1100
100 (2)	Westg.	SK-173	850
100	Reliance	651-T	850
100	Reliance	1050-T	500
100 (5)	Reliance	1050-T	400/1200
75 (3)	Westg.	SK-153	1150
75	Reliance	651-T	850
75	C.W.	CMC	975/950
60	G.E.	CDP-169	1750
50 (2)	G.E.	BC-31B	1700

SLIP RING MOTORS

H.P.	Make	Type	Speed
600/800	G.E.	IM	257
600	C.W.	181A	514
500	Westg.	CW	450
500 (2)	G.E.	IM	450
450	G.E.	IM-17B	880
400	G.E.	IM	600
350	Westg.	CW	435
300	Westg.	CW	1175
250	G.E.	IM-17	600
100	Westg.	CW-868A	695
100	El. Dy.		480

SYNCH. MOTORS

H.P.	Make	Type	Speed
700	Westg.		450
600	Westg.		450
475	Westg.		720
400	El. Mchy.		300
250	El. Mchy.		257
200	A.C.		1200
180 (2)	G.E.	ATI	900
150	G.E.	TS-965R	720
100	G.E.	ATI	720
100	Westg.		600
40	G.E.	TS-7536	900
30	G.E.	TS-7452	900

SQ. CAGE MOTORS

H.P.	Make	Type	Speed
250	G.E.	K-6335	1800
200 (3)	G.E.	IK	1800
200 (4)	G.E.	IK	1150
150 (2)	Westg.	CS-771C	1760
150	C.W.	SC-35B	1750
150	Westg.	CS	1175
125	Westg.	CS-856C	700
100	Westg.	CS	1760
100 (2)	Westg.	CS	870
100	Westg.	CS-856A	388

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#165 TOLEDO, Toggle, Tie Rod, Double Back Geared, 125-ton, 14"-10" stroke, M.D.

#247 HAMILTON, S.S.S.C., Tie Rod, Back Geared, 115-ton, 7" stroke, G.M.D.

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7A Jones & Lamson Turret Lathe Serial #60450

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#47 Heald Single End Barematic Serial #4640

DB 2112-A Excello Single End Barematic Serial #101688

42" Bullard Vertical Turret Lathe Serial #14001

36" New Era Bullard Serial #7136

#306 Hanchett Vertical Surface Grinder Serial #508-17

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26" Bullard Vertical Boring Mill—Spiral Drive Serial #15008

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Lathe, 918 Rivett cabinet, collets (1946)
Lathe 14" Cinn. 12-speed G.H. 30" ctrs, taper att.
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Mill, Thread, 12x30 Morey-Shields, Int. & Ext.
Mill, Vert. #3 Hercules Hvy. Duty (1953)
Pipe Machine, 2" Landis with 3 die heads (1948)
Press, Niagara 156, 86.6" str. MD (2)
Press, OBI. #6 Toledo, motor drive
Shear, Univ. Buffalo 25SSBC., 1¼" squares
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1-3/4"	16-1/4"	4 MT	25.38	2.50
1-7/8"	16-1/2"	4 MT	29.34	3.00
1-29/32"	16-1/2"	4 MT	30.19	2.50
1-15/16"	16-5/8"	4 MT	31.09	3.50
2-1/16"	17-3/8"	5 MT	36.71	5.00
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Qu.	KW	Make	R.P.M.	Volts D.C.	Volts A.C.
1	2250	Whse. (3 unit)	720	600	4160/2300
2	1275	Whse.	720	600	2300
3	1000	Whse.	514	600	11000
1	750	G.E.	900	250	2300
3	500	Whse.	1200	125/250	2300/4000
2	500	Whse.	900	250	4000/2300
1	500	C.W.	720	275	2300/440
1	400	C.W.	1200	125/250	2300/4000
1	300	G.E.	720	250	2300/440
3	200	G.E.	900	125/250	2300
2	200	G.E.	720	250	2300/440
1	150	G.E.	720	250	2300/440
1	100	Whse.	900	275	2300
1	100	Cr. Wh.	1200	125	440/220
1	85	Cr. Wh.	1200	250	4030/2300

LARGE MILL MOTORS

Qu.	HP	Make	Type	Volts	R.P.M.
2	2000	Whse.	Rev.	525	600
6	1500	Whse.	Encl.	525	600
1	1200	G.E.	MCF	600	350/790
4	800	Whse.	Encl.	525	600
1	600	Whse.	Mill	300	250/550
5	700	Whse.	Encl.	270	300/700
2	600	Al.Ch	Mill	600	300/600

SYNCHRONOUS MOTORS

Qu.	HP	Make	P.F.	Volts	R.P.M.
2	1700	G.E.	.80	2300	360
1	1000	Whse.	.80	2300	360
1	800	El. Mchy.	.80	440	1200
1	750	G.E.	.80	2300	450
2	700	G.E.	.80	2200	1200
1	300	G.E.	1.00	2200	1200
1	250	G.E.	.80	440	450
1	250	G.E.	1.00	2200	514
2	200	Whse.	.80	440	1200
1	200	G.E.	.80	2300/440	720
1	200	G.E.	.80	440	450
1	150	G.E.	1.00	2300/550	900
1	150	G.E.	1.00	550	600
1	150	Whse.	.80	440/220	450
2	125	G.E.	.80	4000/2300	1200
3	125	El. Mchy.	1.00	4800/2400	900
1	125	G.E.	.80	2200/550	900
2	100	G.E.	.80	440/220	1800
2	100	G.E.	.80	440	600
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1	200/250	El. Dy.	SRC-22	400/1200
1	180	G.E.	MPC	600
1	150	Whse.	SK-201	300/900
2	125	Whse.	SK-184	575/850
1	125	G.E.	MPC	400/600
6	100	El. Dy.	2808	450/1350
1	90/160	G.E.	MPC	625/1135
2	75	C.W.	53-H	860
3	50	Whse.	SK-131.5	600/2200
1	40	Whse.	SK-140	500/1700
1	40	G.E.	CD-123	500/1000
1	35	Whse.	SK	250/1000
1	32½	Whse.	SK-150	400/1200
1	27½	El. Dy.	15-S	450/1350
3	25	Whse.	SK-93	1800

SQUIRREL CAGE MOTORS

Qu.	HP	Make	Type	Volts	R.P.M.
2	1250	Al. Ch.	ANW	2300	1180
1	800	G.E.	KT-573	2200	1180
1	400	G.E.	K	2200	514
1 (vert.)	300	G.E.	KF-574	2200	580
1	200	Whse.	CR-872C	2200	1160
1	200	Al. Ch.	AR	440/220	580
2	125	Al. Ch.	AR	2200	1750
1	125	Al. Ch.	AR	2200	690
1	100	Whse.	CR-663C	440/220	1750
1	100	G.E.	KT-347	440/220	1160
1	100	Al. Ch.	ANW	2300	720
1	100	G.E.	KT-562	444/220	570
1	100	Whse.	CS-938	2300	495

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Qu.	HP	Make	Type	Volts	R.P.M.
1	1500	G.E.	MT-498	2300	360
1	500	G.E.	MT-413	2200/440	710
1	500	Al. Ch.	ANY	2200	514
2	500	G.E.	I-18-M	2300	450
1	450	G.E.	I-14-M	2300	505
1	400	G.E.	MT-412	2200	600
1	400	Al. Ch.	ANY	2200	505
1	400	G.E.	MT-424	2300	360
3	400	G.E.	I-17B-M	2200	900
2	300	G.E.	MT-416	440	450
1	250	Whse.	CW-1106	2200	435
1	250	Whse.	CW-937	440	1160
1	250	Al. Ch.	ANY	440	720
1	250	Whse.	CW	2200	450
1	250	G.E.	MT-414	2200	300
1	200	Whse.	CW	440	600
1	150	G.E.	I-12-M	2300	600
1	150	G.E.	I-17-M	440	450
1	150	Al. Ch.	ANY	440	720
1	100	G.E.	I-14-M	2200	720
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3	750	Al. Ch.	ODSC	3	6900-6327-460
3	500	G.E.	H	1	24,000/21,000-2300/4000
3	400	Whse.	OISC	1	22,000 (taps) 2300/4000
3	400	Whse.	SL	1	13,800-2300
3	333	Whse.	SL	1	69000/34500-2400/4160
3	333	G.E.	H	1	13,200/11,880-2300/4000
1	300	Whse.	SL	3	11,500-440
1	300	G.E.	HT	3	12,000/10,-800Y-240/480
2	150	G.E.	HT	3	2400/4160Y-240/480
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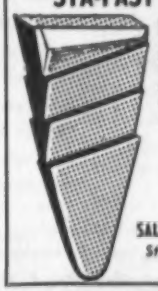
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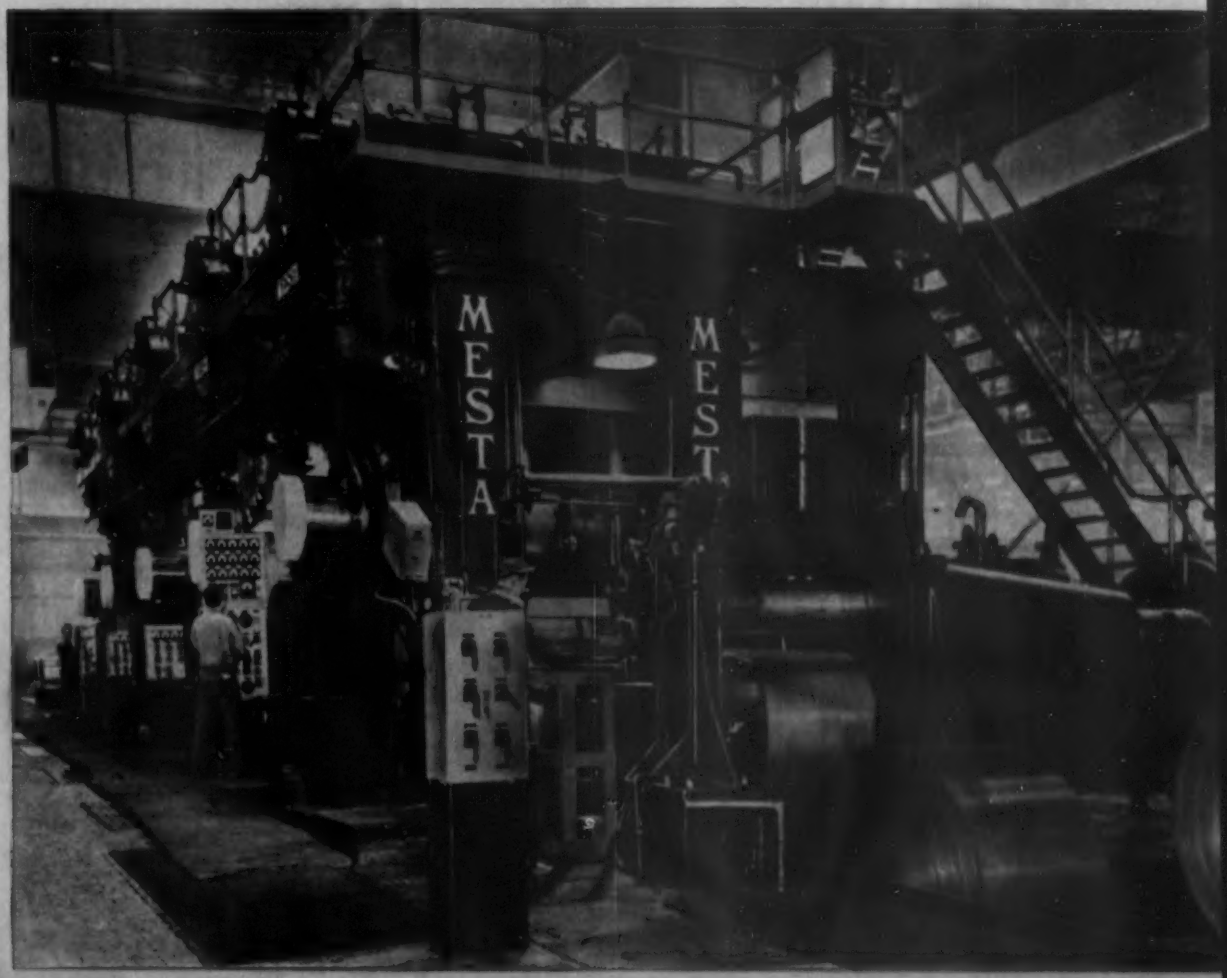
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